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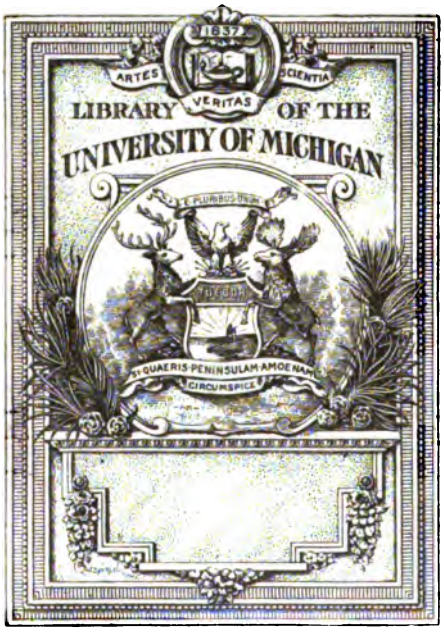

THE GIFT OF
Mo. Bd. of Agriculture

NINETEENTH ANNUAL REPORT

UNIV. OF MICH.
JAN 8 1908

OF THE

Missouri

STATE BOARD OF AGRICULTURE

OF THE

STATE OF MISSOURI

FOR THE YEARS 1886-'87.

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THE NINETEENTH ANNUAL REPORT

OF THE SECRETARY OF THE

MISSOURI STATE BOARD OF AGRICULTURE.

To the General Assembly of the State of Missouri:

During the early part of the season the crop prospects were so favorable that it is doubtful if, as a whole, the outlook has ever been more cheering for our farmers.

The monthly crop reports included in the body of this report will show the progressive crop changes during the growing season and will give the estimated harvests. All early crops gave large yields of fine quality. This statement is particularly applicable to hay and wheat, clover especially, yielding a fine crop. Oats, harvested later than the above crops, gave an average yield, while all subsequent crops felt the influence of the severe drought. Corn, from this drought influence has returned a much reduced crop from the average yield. Pastures during the spring and early summer were exceedingly fine. Their surplus food enabled them to carry stock through the midsummer drought in good condition. This surplus, however, was fully consumed and left them short of full feed for the dry fall months. Cattle, therefore, came early to winter food, and in a condition of flesh scarcely up to the average.

The entire cultivated crops of the year fall but little, if any, below those of an average year.

It is in the growth and sale value of our grazing stock that the farm income is most curtailed. Our farmers had become accustomed to low priced pork, wool and wheat, and if not reconciled to low rates in these crops, have not been seriously disappointed at their continuance.

Cattle have been the last to find a lower and even a low range of prices. To-day, no staple farm product, unless it is wool, is selling at rates satisfactory to our farmers, and upon which rates our farming, as now carried on, can realize any profit.

I will not venture into the sphere of prophecy regarding prospective prices of farm products. One thing is now well settled, namely: That our past spoliation system of farming, as pursued in the past, will be unable to support the farmer in the future as the age is being supported, and as the age and right demands that the farmer should be supported.

Machinery has served well the American farmer in his extensive system of farming, and has enabled him to meet all competion of peoples growing crops by muscular power. Machinery has taken the cream from our rich soils and is now in growing favor with our competitors, thus setting cheap labor and machinery against high priced labor and reduced farms.

INTENSIVE FARMING.

Intensive farming or machinery, plus brains, unfolding higher and progressive methods of farming, will restore our profits and maintain the prestige of American farming. Already are there visible signs of departure from old methods and of the adoption of new processes. Old methods will doubtless linger beyond their inherent right to existence, and new methods will have a less ready welcome than our needs will justify, yet we are at the parting of the two systems. I welcome the new, and as it is my province, seek to hasten it. I deem it profitable to put in contrast the results of the old method and the possibilities of the new method, the latter being founded upon science and art. In this presentation I shall outline a system of farming that I believe, and I rest this belief upon experience, will add vastly to the material wealth of the State, and to the resources of those who pursue the type of farming outlined.

RESULTS OF THE OLD SYSTEM.

The old system, as pursued by the average farmer, has been one of waste, as follows:

By constant tillage a waste of soil fertility, and when crops are sold a crop exhaustion of soil nutrients of plants; the manure, both solid and liquid, has mostly run to waste. The corn fodder has not been one-tenth consumed, while straw has been no better husbanded; hay has been tramped out about stacks and leached out by rains; corn has

been used with extravagance. Our methods, as a whole, have been destructive of the farm and of farm products instead of upbuilding in its tendency.

I will assume for the basis of my calculations that two young men started out in life as farmers fifteen years ago; the first pursuing the grain selling type of farming, the second following farming in the light of the best modern thought and research. Each young farmer is to have had the present average sized farm of the State by the last census or 126 acres.

THE CONTRAST OF METHODS.

Farmer No. one raises sixty acres of corn, forty acres of wheat, and has twenty-six acres to grass and hay. His crops and income may be gauged from the census and from the statistical returns of the Department of Agriculture at Washington. From figures elsewhere made by me from those returns, it is seen by dividing the period from 1864 to 1884 into four periods of five years each, that the crops for each period were as follows:

	Yield of wheat.	Yield of corn.
1st period of 5 years.....	14. bushels.	30.8 bushels.*
2nd " "	12.4 "	32.1 "
3rd " "	11.9 "	27.1 "
4th " "	11.7 "	26.6 "

Between the central period of the first and last five years of the twenty years under review is but the fifteen years under consideration.

The income of the first period of farmer No. one would be as follows:

60 acres corn at 30.8 bushels at 25 cents a bushel.....	$462
40 acres wheat at 14 bushels at 70 cents a bushel.....	392
10 steers fed on straw, corn fodder and pasture, yearly.....	200
Total.....	$1,052

*This was a severe period. The previous two years gave 38.7 bushels, which, if included in first period, gives a yield of 33 bushels.

For the sake of simplicity, I have regarded everything sold. Whereas the six horses that the farm requires have got to be grained and fed hay from the farm, requiring a part of the area above regarded as devoted to sale crops.

Fifteen years later our farmer finds that his exhaustive system of farming has cut down his yields, as seen in the table given. His income then stands as follows :

60 acres of corn at 26.6 bushels at 25 cents	$399
40 acres of wheat at 11.7 bushels at 70 cents	327.60
9 steers fed at $20	180
Total	$906.60
Less in fifteen years of poor farming of yearly income	$146.40

This is deliberately farming towards poverty, and inability to educate children, adorn homes, build roads and enlarge the comforts of life. When taxes, cost of keeping of horses, their depreciation, cost of tools, cost of hired help, threshing bill, and seed are taken out of the gross income, this system yields but poor returns for the owner of the farm. It must be distinctly understood that these figures of yield are official and represent the average of good and poor farms. The figures are not then overdrawn.

FARMER NO. TWO ; OR, GOOD FARMING.

I shall make an estimate of the returns that farmer No. two might have been now receiving, had he fifteen years ago started out on a comprehensive, far-reaching scheme of farming. This presentation is given to make the contrast between the two systems, to enable me to present what I regard as a good system of husbandry, and to note the competency of good farming to maintain the supremacy of American agriculture, and to sustain wealth and culture on the farm as well as to sustain the wealth and strength of the State.

STATEMENT.

I will make up the income account of farmer No. two, and afterwards present in brief the methods and in part the philosophy of the methods by which such superior results can be obtained. To most persons the income account will seem like an exaggeration. I therefore desire to state, after mature consideration, that experience assures me that the figures are all attainable by application of the proper forces, namely :

genius or intelligence, force and capital. These are to be applied in no halting measure, but with the full intent to exhaust the capacity of each in securing from the farm its maximum result consistent with profit. The maximum gross results are far beyond the figures given below, and at a limit that modern research has shown to be so great that it is unwise to attempt to state their limit.

FOR 126 ACRES.

12 acres—Corn at 80 bushels, 960, and 40 tons of fodder.		
12 " —Oats at 60 bushels, 720, and 24 " "		
12 " —Clover at 4 tons—two crops 48 " "		
12 " —Wheat straw, 24 tons.		
12 " —Timothy at 4 tons—2 crops 48 tons of fodder.		
12 " —Timothy at 3 tons—2 crops 36 " "		
	" "	
Retained on farm of corn and oats 1680 bushels .... 220 " "		
12 acres wheat* at 40 bushels, 480 bushels at 70 cents		$336 00
30 cows, 250 pounds butter each at 25 cents.....		1,875 00
30 steers and heifers for annual sale, average 1,400 pounds at 4¾ cents..		1,995 00
100 lambs at 4¾ cents.....		400 00
900 pounds wool at 25 cents.....		225 00
100 shoats at 8 months, 225 at 4 cents.....		900 00
Orchard and sundries, including poultry		500 00
Total receipts...		$6231 00

*I should expect to get a crop of clover after oats, and of timothy after wheat, the same year the grain is grown, after the ground is very rich, but will not estimate in this case.

This large income has possibilities in it. The other system has not. No attempt was made to arrive at the net result to farmer No. one. It was so obvious that there was nothing in it worthy, after all bills were fairly paid, that it seemed superfluous work. Furthermore it would involve debatable details, which it is unnecessary for me to consider. For the same reason regarding details, I shall go no further with the above account than to state the main costs. The justice of these costs to be estimated will appear as the consideration of this subject progresses.

ESTIMATE OF CHIEF EXPENSES.

Four men will do all of the work at a cost of $1,200.

The early matured fine beeves will consume with the 30 milch cows, 110,000 pounds of grain yearly.

Necessary horses will consume 22,000 pounds of grain yearly.

100 pigs, 90,000 pounds of grain.

100 sheep, 19,000 pounds of grain.

Total grain fed, 221,000 pounds.

Grain grown, 76,800 pounds.

Cost of purchased grain, $793.

Added, $400 paid for pasturage.

We may add to this $500 as the extra annual cost in interest and repair of buildings and machinery.

This gives a total of $2,893.

To this bill may be added cost of dairy woman.

This will not be the cost above that of farmer No. one, as farmer No. one has also to hire to a considerable extent, as well as is under the necessity of feeding his horses.

PIVOTAL POINTS IN ABOVE SYSTEM.

This result is not visionary, but rests upon well defined practical and scientific truths. Before reviewing those truths it must be stated again that the above figures are not final, hence I have not struck the balance sheet for the profit that may be involved. A fine profit, however, is involved when such farming is pursued in the light of present knowledge. Most farmers will question the results derived from the use of the small amount of grain fed. In this field I have had a long experience and refer those interested to an article on feeding by the writer, in the report of this Board for 1883. The cattle stated as raised will not consume all of the coarse foods grown on the farm when they are fed in the warm barns that belong to this system. The large stock kept is largely fed upon foods now wretchedly wasted, which, thanks to science, can be utilized to great advantage and so utilized as to avoid the use of heavy rations of grain. The economy of shelter on food feed, the economizing of all roughness by wise and scientific food combinations, and the prudent use of grains with these combinations, amply enables us to fulfil the figures named.

THE LARGE CROP.

These are derived by the use of several factors: First, the manure is all saved by cement tight cellars which hold both the solid and liquid

droppings. (For making, saving and using manures see last Board report). Second, these manures are increased by the purchased foods which are largely foods that make a rich manure, and also by gathering manures from outside sources. Third, all the foods raised on the farm are consumed on the farm for the distinct purpose of returning to the soil the plant food derived from it. Fourth, a goodly share of the revenue is derived from butter, a product that does not carry from the farm any materials that are regarded as plant food in the sense of soil exhaustion, as the materials composing it are derived from the air by plants. That the amounts and the price of butter used can be realized, I cannot now stop to recount the evidence. It is all within the range of ordinary genius when applied to the task and is exceeded in practice by many well-known dairymen. All of the above facts and their bearings on the philosophy of farming have been set forth by me in previous reports of this Board. A review of these reports, I believe, will convince those interested in the soundness of the claims I make for farmer No. two, as regards points just referred to.

ROTATION OF CROPS.

Capital, barns for the protection of stock, manures and crops, the utilization of all foods, including straw and corn fodder by scientific food combinations, involving the use of less grain, the purchase of rich manure-making foods, the saving and use of all manure, the making of butter that does not carry from the farm needed elements of plant food, brains, ambition to set up, and force to achieve a high standard of excellence in farming, have thus far been the factors stated as involved in the system of farmer No. two.

But there is another most valuable factor, involving several aiding forces, in his system of cropping. To these factors I shall devote the balance of this report, and the main portion of the suggestions I have to offer in this attempt to aid our struggling agriculture, now endeavoring to mark out for itself new and advanced lines of movement.

It will be observed that our farmer No. two has followed a six years rotation of crops. I will state the advantages that I believe to exist in a good rotation of crops, and incidentally, in part, my reason for the one outlined, which is being pursued by the writer at our State College Farm.

DISTRIBUTES LABOR OVER THE YEAR.

I. A good rotation well arranged gives a nearly uniform occupation for labor over the year. Our present system of cropping by a

succession of crops of the same kind, like corn after corn and wheat after wheat, involves a demand for extra labor for a short period of time. Everything done is performed in a short time in a great rush, and hence, under temptation to do the work in hand in a slovenly manner. An extra price is paid for indifferent work. The system of short employment has demoralized farm labor, and beyond controversy has placed it at a disadvantage. The system proposed requires quite as much labor in the winter as at any other season of the year. So closely does it distribute the labor needs of the year that farm improvements and extra jobs of work at repairs, etc., will absorb all surplus time. At no time of the year will it be found necessary to call in extra help when proper machinery is used, such as hay loaders and hay unloaders, and other timely machinery for crop handling. While the just rights of labor are respected by these methods—methods which make good interested and permanent farm labor, the construction of cottage houses relieves the farmer's wife from the most disagreeable duties of the farm household, namely: The boarding of hired help, while at the same time it affords, often, available aid to the farm household from the family of the employe.

Again, this even distribution of labor throughout the year, insures the most thorough work, through the available time to devote to good work. Plowing and tilling is not required when too wet nor when too dry. Tillage is made thorough and abundant. All crops are handled at the right time, and over ripe hay is not necessary nor is the handling of crops in threatening weather required. I need not specify throughout the entire list of grains, which run throughout the year. I desire to emphasize a sweeping gain, that alone will justify a radical change in our system of farming, to wit: It enables us to save and use to great advantage all of the straw and corn fodder, now yielding scarcely one tenth of what they may be made to do, for animal nutrition. In a previous report I have stated and shown that these wasted portions of these fodders alone are capable of wintering more stock than is now kept in the State. When advocating the utilization of these fodders I have been often impatiently told that it is not feasible to do it and it is a waste of time to consider it. I will review the years labor under the proposed system, which will show that a system made to gain in the place of one that wastes will work:

First, oats are sown in April, twelve acres requiring for two pairs of horses and two men two and one-half days. The ground, of course, is to be plowed in the fall. Second, the corn ground has to be fitted. This has been plowed in the fall, and if not then manured nor manured during the winter, may be manured by power spreaders in

five days for two teams. Three more days will harrow and plant it. During the last half of May and the first half of June the work necessary is only this corn which is to be thoroughly cared for, leaving time for the dairy, fences, shingling buildings, drainage, etc. Third, by the middle of June our rich farm gives its first crop of clover, twelve acres, which is disposed of in three or four days, after which twelve acres of wheat are quietly bound in a day or two. Fourth, the last of June or the first of July, finds twenty-four acres of timothy ready. With mowers, rakes, hay loaders and hay unloaders, six to seven days will readily dispose of it. Fifth, twelve acres of wheat is now drawn into the barn in a couple of days. Sixth, the oats will now be cut. Seventh, after a short drying the oats are taken to the barn. A few days time is now at command to plow for twelve acres of wheat, to make improvements, or to visit. Eighth, by the last of July the second crop of clover of one and one-half tons per acre is taken in two days of actual work. Ninth, wheat manuring and general work will fill the time to second week in August, when the second crop of timothy is taken quicker than the first. Tenth, by September first, the wheat crop is all manured. Eleventh, September first, the twelve acres of corn is put into small shocks of 6x4 hills in order to save good fodder. This will be a weeks work for the men. Twelvth, apart of the force of four men will harrow and put in the wheat in two or three days. A little before this date the cows will be dropping their calves for winter dairying. Warm barns will admit of this practice, while available time and high-priced butter at this season, demand winter dairying. Thus, butter for October and November will divide the time of farm help some. The thirteenth natural division of time finds our four men husking out the corn and carrying the fodder to the barn. This will require from the middle of September until the middle of October, while carrying on the dairy. In all of this work the owner may be expected to aid, although his services have not been calculated upon as necessary. He may be expected to do enough to fill emergencies and to make good any possible underestimation in these figures. Fourteenth, or for the last of October and all of November we have only the plowing of the corn and oat ground as necessary out door work. Time will now be available for repairs, improvements, collection of manures, visits, etc., etc. Stock will be coming to the barn in November and requiring care. Time will be all well occupied. Possibly warm barns will invite dropping of the lamb crop at this time for early spring sales. The winter months will keep the men busy with one hundred shotes, one hundred sheep and one hundred and twenty cattle, including cows, and in addition dairying. It must not be understood that we winter spring shoats. Never will a pig pass seven to nine months of

age in our system, with warm barns two crops will be raised yearly if desirable. I have estimated on one crop. Two crops of fifty each will be a good practice. The year's wood for all the families is to be got up. Threshing may or may not be done at this time. It is better done during rainy days in the fall. Experience teaches me that this system is better for all parties than good crops of wheat and corn, requiring periodical rushes of labor and then of idle labor, requiring also waste in fodder values nearly equal to his grain sold and fully equal to it when fertility of the farm removed is included.

ROTATION TO PARASITES.

Each species of plant has its own specific enemies that flourish best when a crop is confined to the same ground annually. The roots of our plants have enemies of both the vegetable and of the animal kingdom. When the peculiar food or crop upon which they best thrive is constantly upon the same ground, then these enemies develop to a vital entent, and make sad and often mysterious inroads upon our crops. This is in a very marked degree likewise true of the above-ground fungi and insect enemies of plants, as observing farmers well know. It will be seen further along that rotation gives a more vigorous plant. This fact coupled with the fact that the annual change of ground of a plant often largely and sometimes wholly removes it from its enemies, very greatly removes the crop beyond the power of insects and fungi to destroy it.

Experience has taught the world the advantage of this favoring point. Experience likewise taught the farmer far back in history the advantage of crop rotation. Its philosophy was not understood, and could not be, before the development of the natural science. For this reason and others the old rotations were not as perfect as we are now taught to make them. Yet it is a powerful argument given to the present generation to make these rotations as perfect as it is possible for science and art to lay them out.

ROOT DEVELOPMENT TO ROTATION.

I. Careful study of the root development of our farm crops has shown that they are dissimilar in many respects. Perhaps the most obvious distinction is the variation in length, direction of their growth, and weight. Several farm plants, more notably those of tropical origin, have roots growing near the surface of the ground, delighting to feel the influence of the sun of the warm surface. Corn, hungarian-grass, and others are examples. The roots of those plants are found

mostly within the first four inches of the soil, while the bulk of them are still nearer the surface, as seen by actual investigation of them.

Another class of plants, represented by wheat and potatoes, root deeper than the above crops. Still another class of plants, of which clover is the best type, send their tap roots direct into the subsoil and feed by their lateral rootlets quite heavily from the lower areas of the soil. Clover has long, by both practical and scientific men, been regarded as a crop that feeds heavily in the subsoil. It is known beyond question that plant food may leach from the surface into the subsoil. Sir John B. Laws finds as high as fifty pounds of nitrogen, as much as is found in an average crop of clover, yearly in the waters of his lysimeters.

The significance of the above truths is found in the fact that if divers crops feed in different areas of the soil the alternation of crops results in feeding new areas of the soil, or it becomes in part the equivalent of feeding on a new farm, or a farm under a farm is opened up to use. Corn after corn means the feeding of the surface area of the soil.

II. A second phase of root development is found in the actual weight and composition of roots. The following table is derived from the weighings and analyses of a German. We have a few American tests which are not as complete.

COMPOSITION OF THESE ROOTS PER ACRE:

	Weight of roots.	Nitrogen.	Lime.	Potash,
Barley	1,515 lbs.	22 lbs.	40 lbs.	9 lbs.
Wheat	2,240 "	22 "	72 "	17 "
Rye	3,400 "	62 "	99 "	30 "
Clover	6,580 "	180 "	246 "	77 "

There is much significance in the weight and composition of these roots. They partly, but only partly, explain the reason why some crops are so much more favorable to precede a given crop than others are. The roots of clover crop, grown partly from sections not penetrated by other crops, contain food enough in their roots, so derived as to make food for a good crop of most all plants. The next section will present this matter in a new light.

FEEDING CHARACTERISTIC OF PLANTS TO ROTATION.

Plants, like animals, have unlike feeding characteristics. Farmers all notice that our various domestic animals have tastes that lead them

to select unlike foods when grazing in the same pasture. The analogy may not be complete yet it measureably exists.

The proportions of the elements of plant nutrition taken vary. But beyond this, the power of each plant to obtain these elements varies. That is, as an illustration, clover has a great power to gain nitrogen from natural sources while wheat has a very limited power to gain this material from such sources. Turnips readily avail themselves of potash from the soil but are lamentably deficient in ability to gather phosphoric acid. This difference of power is probably due in a large part to the action of the various acids secreted in the roots of the various crops, and that have a solvent action on the soil varying for the several materials in each crop. Be this as it may, the fact is clear, and equally clear is our duty to grow crops in rotation and thus obtain this benificient influence of each of the crops in the impartial and unequal decomposition of the soil.

Clover is a most admirable illustration of the practical value of this truth. The contrast to be immediately made is due in part to the season of the growth of clover and the depth of its roots.

Clover will contain in a good crop, one hundred and twenty pounds of nitrogen, while a good crop of wheat will contain but about one-third as much or forty-four pounds of nitrogen. Clover will easily gain this amount by its own unaided powers on a soil where wheat would nearly starve from its inability to gain forty-four pounds of this material. This explains why it is that clover so admirably precedes wheat and gives my reason for following clover by wheat without the intervention of timothy. The weight of the roots and stubble of clover are about equal to its top, and the nitrogen in them is enough for a larger crop of wheat than was ever grown in this State. These roots decay easily and furnish the needed nitrogen for wheat.

Recently, little nodular protuberances have been discovered very bountifully on the roots of clover and the disposition is manifested in some quarters to ascribe the power of clover to gain nitrogen from natural sources to some mysterious influence of these organs, if normal organs they are. This conclusion is not as yet well supported.

VARYING RATIO OF PLANT NUTRIENTS TAKEN FROM SOIL TO ROTATION.

The above suggested power forms one of the most clear and unquestionable reasons in favor of crop rotation. The relative amount of nutrients taken from the soil vary quite radically with the crop.

Thus for every pound of phosphoric acid taken we have the following variations in the following crops:

	Of potash.	Of nitrogen.
In hay	3.11 bs.	3.68 lbs.
In potatoes	3.59 "	2.14 "
In corn	3.43 "	2.00 "
In wheat	1.2 "	2.20 "

Other and more radical differences might be noted. The ratio of phosphoric acid in wheat to potash and nitrogen is seen to be very heavy and a soil, as soils contain less of this element, decidedly, than of the others, will become soonest exhausted of this element if wheat is constantly grown. We have soils in this State containing only six one hundredths per cent. phosphoric acid and at the same time over four times as much potash. Yet the wheat crop contains only one and one-fifth times as much potash as phosphoric acid. At the State College Farm we find that by manuring we can produce threefold as much wheat as the soil will give. The artificial supply of plant food then gives us the bulk of our crop. Suppose ten tons of manure are added to the soil containing as it will, if made from hay, about forty-two pounds of phosphoric acid, one hundred and thirty pounds of potash and one hundred and twenty pounds of nitrogen, it will require but two crops of wheat of twenty-five bushels each to exhaust the phosphoric acid added in the manure, while it will require over five crops of wheat to exhaust the potash added and about three crops to exhaust its nitrogen. To enable a comparison by those interested, I will state that a crop of twenty-five bushels of wheat with its straw will take from the soil twenty pounds of phosphoric acid, twenty-four pounds potash and forty-four pounds of nitrogen.

It is a clear mathematical problem, and capable of but one inference where we depend upon artificial supply of manure, and ninety-nine times out of one hundred where we do not thus depend upon plant food, that wheat following wheat will exhaust the soil in a one-sided way and soon reduce the capacity of the soil to grow wheat or any other crop, especially those that require much phosphoric acid or that have a low power to get this material.

This is but a single illustration of a great law, and teaches us by all means to rotate our crops. By so doing we get, or may get, a crop following wheat that takes lightly of phosphoric acid and heavily of

potash. While potatoes need not necessarily be that crop, yet they will serve well this purpose, as they contain three and one-fifth times as much potash as phosphoric acid, and would get the potash slightly before the phosphoric acid would be exhausted.

The above influences are most important ones, and should receive our most carefull consideration. Whenever we reduce the amount of a single element of plant food in the soil we reduce the capacity of the soil to its capacity. It is the weak link that measures the capacity of a chain. By a proper rotation we exhaust the soil of the various elements of plant food relatively, or to the same degree of rapidity, thus enabling us to obtain its full powers of production for all its elements of plant growth.

LEAF DEVELOPMENT TO ROTATION.

The leaves play an important part in the growth of a plant. About one-half of the weight of a plant is taken in through the leaves derived from the atmosphere. The full function of the leaves in this direction is not known. Enough is known of their work to lead those familiar with their functions to lay down the rule in rotations that narrow and broad leaved plants should alternate with each other.

How far they may gather nitrogen compounds from the air or aid in forming them we do not know; but we do know that they drink in about all of the carbon of the plant, which is nearly one-half of a plants weight, and that all of the food of a plant is organized in the leaf. This includes the roots, whose decay forms the invaluable humus of the soil. Broad leaved plants are popularly supposed to gain more from the air of the all-important nitrogen compounds, a part of which is stored in their roots to feed the following narrow leaved plants which have a low power of gaining nitrogen.

TIME OF GROWTH TO ROTATION.

This factor is an important one, and rests upon the solid grounds of natural law, as do the reasons before stated in favor of rotation.

No food enters a plant until it is capable of being dissolved in water, or rather it enters the plant in solution with the water taken into the plant, or already in the plant. Most of the soil, with a small per cent. as the exception, is not soluble, and hence not available to a plant. If it were otherwise our soil would dissolve away like a lump of sugar and flow away with our rivers. How then, does our soil become available to plants? By the constant disintegration of the soil under the influence of the sun and the chemical agencies of the air

circulating through the soil. This work takes place only in elevated temperatures, just as meat requires warmth to decay. This last suggestion particularly applies to the organic matter of the soil, that alone from the soil supplies nitrogen to the plant, hence it is that crops growing through the heat of summer are able to obtain nitrogen better than those that grow in the cooler parts of the year. The summer sun is constantly decomposing the organic matter of the soil, furnishing nitrogen, among other matters for the use of plants. Sturtevant found in the drainage of his lysimeter for August ninety-seven parts of nitrates in a million parts of water caught, while from April 16th to May 20th he found only twenty-four and seventy-three one hundreth parts.

A good illustration of the importance of the truth sought to be enforced is found in clover and corn. Wheat grows in the fall and winter when nitrogen in available compounds is not being formed but to a slow degree. Corn grows through the heat of the year, when the sun is rapidly oxidizing the organic matter of the soil. I have carried forward for four years upon the same ground trials with the various chemicals for both corn and wheat. These results will soon be published. They shew that nitrogen has very greatly (more than doubling) increased the crop of wheat, while it has not influenced the corn crop.

When we alternate we take advantage of this law and follow a crop that gets its nitrogen easy and leaves a store house of it in its large root development that will be available to the needy crop. Hence again we follow clover by wheat.

ROTATION TO SOIL CONSERVATION.

Successive tillage crops is the most rapid way of soil exhaustion. The soil is kept constantly under the plow, and in the case of corn is cultivated and exposed to the maximum extent to the air and floods. The philosophy of tillage of bare or exposed surfaces, and of soils covered by protecting crops is an obstruse and a most important one. The ground is too broad to attempt to cover at this time.

Several investigators have shown us that bare surfaces have much more of soil nutrients washed from them, or rather leached out of them, by water passing through them, than have sod lands. Sturtevant found his lysimeters gave per acre in water from them:

For sod land, nitrogen..... .30 lbs.
For bare soil, nitrogen..... 218.2 "

All investigators find, also, that the solids are more rapidly lost in bare soil than in sod. Sir John B. Laws finds after thirty or more

years of work that his grass soil now contains more than twice the nitrogen that his tillage soil does.

The loss is not alone by leaching, but also by vaporization. To what extent volatile matters of importance may pass into the air is an unsettled problem. Some loss occurs in this direction from bare surfaces. Every Missouri farmer is aware of the loss from bare ground by surface washing. Perhaps all are not aware of the extent of this loss; a loss that occurs from the finest and best parts of our soil. The Mississippi river carries, it is said, 7,471;411,000 cubic feet of solid matter yearly into the Gulf of Mexico.

Without further elucidation in this broad field, I may safely assert that our system of succession, plow and tillage crops is a system of wastes from whatever standpoint it may be approached. Sod crops are conserving crops of soil resources.

Tillage, it must be faithfully owned, has one grand merit of rapidly hastening soil decomposition and thus furnishing to crops from nature a maximum amount of plant food. This factor is an invaluable one when intelligently handled, and a dangerous one when relied upon as our sole resource. It is when tillage crops and sod crops are intelligently blended into one system that the full merits of tillage are rereceived, while the lowest minimum of its drawbacks is realized.

The alternation of tillage with protecting crops secures the advantage of crops that accumulate organic matter, including nitrogen in the soil, which material in turn is unlocked for some needy following crop. The sun's rays are made most effective by the stirred surface which opens up its pores and interspaces for its disorganizing work. Before the work of the sun has gone to extremes the next crop covers the ground, and by this process the earth is bound together by interlacing roots for the most of the time and little surface washing follows.

ROTATION IN PRACTICE.

Sir John B. Laws has carried out experiments in this field of work. The following statement is from his trial:

A field was divided into two sections. Upon section one, clover was grown. Upon section two, barley was grown. Clover got from the soil or soil and air one hundred and fifty-one pounds of nitrogen; the barley got thirty-seven and three-tenth pounds. The following year he grew barley upon both sections. Where the barley followed itself it derived from the soil or soil and air thirty-nine and one-tenth pounds nitrogen. Where it followed clover it obtained sixty-seven and four-tenth pounds of nitrogen, or in direct language it gave a much larger

crop where it followed clover than where it followed barley. It must be noticed that although clover took four times as much nitrogen from the soil as barley did, yet that same soil was capable of yielding to barley in the succeeding year nearly twice the crop or twice the nitrogen it did to barley following itself, and on a section that had no heavy draft for this material.

This trial furnishes a good illustration of the practical value of rotation, while at the same time it furnishes evidence of the fascinating complexity of the problems of this "Art of Arts," this profession having no peer in its demand for the applied sciences.

GENERAL SUGGESTIONS.

While I have given an abridged statement of the philosophy of the proposed system of farming, more especially directed to one of its phases, to wit, rotations, it must be distinctly understood that the reason is but an attempt to explain a practice sanctioned by long useage of the best agricultural peoples of the world. I hold strong to the belief that an intelligent recasting of our system of farming now generally in vogue with us, would make a revolution in all that pertains to the social and material welfare of our farming communities. This advance, could it be made general, which history forbids us to hope that it will be, would profoundly affect the material, moral and social wealth of the State, spreading its influence to city life quite as much as to the farm home. The multiplication of the resources of farms several fold would create a wealth whose influence upon roads, both country and rail, upon schools, upon home comforts, upon the general attraction and power of farm life and thought and upon commerce, we cannot estimate, but upon whose grandeur the fancy may well dwell with pleasure.

I do not expect such a change to become general for generations, possibly. I affirm in the light of the world's positive knowledge and personal experience, that the young man who says *I will* be farmer No. two, and bends every energy to accomplish his aim, will succeed in fully achieving his purpose. The few will accomplish what the many might and ought to. To the latter we appeal to keep up to the level of the best.

In conclusion allow me to express the conviction that Missouri does well to encourage better farming through its Board of Agriculture and its State Agricultural College. The prosperity of every child of the State and the State's own happiness and greatness is wrapped up

in its agricultural progress. Being the basic industry of the world its importance can not be put in comparison with any other, nor can the State's fostering care of it meet the jealousies of any other industry as it is the foster mother of them all.

Respectfully submitted,

J. W. SANBORN, Sec'y.

ANNUAL MEETING OF THE BOARD OF AGRICULTURE FOR 1886.

AGRICULTURAL COLLEGE BUILDING,
COLUMBIA, MO., Nov. 3, 1886.

In accordance with the law, the Board of Agriculture met in the Agricultural College building at 10 A. M., Nov. 3d., with the following members present:

S. S. Laws, LL. D.,
J. A. Potts, Esq.,
M. F. Doud, Esq.,
B. O. Cowan, Esq.,
Abiel Leonard, Esq.,
J. R. Rippey, Esq.,
J. W. Sanborn, Secretary.

J. H. Fulbright, Esq., arrived on the afternoon train.

As our former President, Hon. John Walker had resigned and the Vice-President, Hon. H. Eshbaugh had been removed by death, the Secretary, Mr. Sanborn called the meeting to order.

On motion of Mr. Doud, J. W. Sanborn was chosen temporary chairman.

Mr. Sanborn then proceeded to review the work of the Board for the preceding year, and to outline the work that might be done.

At the conclusion of the Secretary's remarks, Mr. Doud moved that a committee be appointed to draft resolutions, expressive of the Board's sorrow for the irreparible loss incurred in the death of its former Vice-President, H. Eshbaugh, and the high esteem in which it holds his memory. Voted.

The Presiding Officer named Messrs. Doud, Potts, and Rippey as the committee.

The Board, on motion of Mr. Doud, then adjourned until two P. M.

TWO P. M.

Met according to adjournment to hold an Institute meeting, to which the public had been invited.

Mr. Sanborn resigned the temporary chairmanship, and on motion of Mr. Leonard, Mr. J. H. Potts was chosen to fill the vacancy.

On request, Mr. Sanborn gave a talk on "How to farm successfully."

The entire afternoon was taken up in the discussion of the subject, but as the Secretary was speaker no notes could be made of the various questions and answers. The opening remarks of this report contain much of the body of the remarks of the Secretary.

The meeting was then adjourned to meet in the University Chapel at 7:30 P. M.

EVENING SESSION.

Met in the University Chapel at 7:30 P. M., according to adjournment, with President Potts in the chair.

The attendance was not large.

Mr. Cowan was the first speaker introduced who read a valuable paper on "Cattle Breeding," which will be found in the body of this report. This was followed by remarks from Gen. Guitar, Dr. Laws, Mr. Doud and the Secretary.

Dr. Paquin being called upon responded by giving a brief account of his visit to Paris to study in the laboratories of M. Pasteur and others in his special field of work.

An adjournment was then taken until 10 P. M, the next day.

BUSINESS SESSION.

Met agreeably to adjournment.

On motion of Mr. Doud the reading of the minutes of the last annual meeting was call for, but as they were very full it was decided that to save time, a copy be given each member.

On motion of Mr. Doud, a committee of two was appointed to settle with the Treasurer.

Messrs. Doud and Leonard were appointed as the committee.

Mr. Doud called for a statement from the Secretary of the work of the Farmer's Institute meetings. This was given.

Dr. Laws then called attention to the part taken by the Agricultural College Faculty in the last Board report, remarking upon the great value of the report as a contribution to the agricultural literature of our State. He also offered a few general remarks in advocacy of the institute meetings. He said: "By this means the experiences of farmers are made common property. It is the gathering together of those experiences which makes common property of truths."

Mr. Doud, asked that Col. E. C. Moore, a former member of the Board present with us, be invited to give a talk.

Mr. More thanked the Board for its cordial invitation to address them, but respectfully declined.

The Secretary then presented the following outline of the work the Board might do and changes of the law desirable.

I. A change of the date of annual meeting, as election now interfered.

II. The life tenure of office of members needs changing.

III. Is it desirable for the Board to hold fairs including Fat Stock Show.

IV. I suggest the propriety of premiums for drainage, for early maturity of pigs, and for the best crop of corn, to be given under careful regulations.

V. Shall Secretary have authority to call Institute meetings.

VI. Shall we print in German.

VII. Should have $1200 for clerk, as old compensation secures men, who if of merit, stay just long enough to learn the work and to become useful.

VIII. Our Assessors law needs extending to include crop areas, crop yield, etc., as is done in Kansas and Illinois.

IX. More volumes of our report should be in cloth.

X. What shall we do about our State Horticultural Society, why publish their work in a separate volume when the laws requires that this Board shall publish their proceedings. Also the law requires County Agricultural Societies to make their reports to this board.

Mr. Doud stated that as the foregoing recommendations from Prof. Sanborn contained only such material as had grown out of his experience, and as all deserved attention and free discussion, he thought it best that it be gone over in detail, and each clause considered. He

also stated that he hoped each member would remain in town until all the work was fully done.

Moved by Mr. Cowan, that the General Assembly be requested to change the date of the annual meeting to the 3d Tuesday in October.

Mr. Rippey suggested the 2d Wednesday in November.

Mr. Sanborn said the latter date would be too late to organize Institute meetings.

Mr. Leonard agreed that the 2d Wednesday in November was the best.

Mr. Doud thought the last Wednesday in February cleared all objections.

Mr. Rippey thought the political campaigns stood in the way and fall fairs might interfere.

On motion of Mr. Doud, the date was balloted for, and the vote taken stood 5 in favor of, and 2 against the 3d Tuesday in October.

Mr. Doud discussed the term of office, advocating a change from life tenure to a shorter period. Our present system, he said, was liable to perpetuate in office men who will do nothing to promote the cause of agriculture.

Mr. Rippey moved that the term of office be changed from life tenure to a term of four years. Carried.

The subject of Fairs was next considered.

Mr. Doud briefly discussed the importance of good meat and the necessity of encouraging our Fat Stock Show, stating that he believed the State should aid the show. He also said: "I believe that if this Board should aid this move it would commend itself at once to stockmen."

Mr. Rippey moved that an adjournment be taken until two P. M.

Dr. Laws, with Mr. Rippey's permission, read that portion of the Missouri Statutes which defined the powers of the Board; the following being a copy of the section referred to:

The Missouri State Board of Agriculture, and their successors, shall have power to adopt such by-laws and make such rules and regulations for the government of said Board, and the management of its affairs and business, as they may deem best calculated to promote the interests of agriculture, and as shall not be inconsistent with the constitution and laws of the State of Missouri and of the United States. (G. S. 320, § 5.)

The reading having been completed, Mr. Rippey's motion to adjourn was again considered and voted.

AFTERNOON SESSION.

Met according to adjournment.

Mr. Potts in the chair.

This being a public meeting, a number of farmers were present who manifested a decided interest in the exercises of the evening.

Dr. Paquin was the first speaker introduced, who gave a talk on "Indigestion among domestic animals."

Only a brief synopsis of his remarks can be given. The speaker stated that his reason for choosing this subject was, that this was the prevailing and most prolific cause of sickness among the domestic animals of this neighborhood. In order to understand the subject properly, it will be necessary for us to know something of the digestive apparatus of the animal.

It is necessary in order that digestion be complete, that each part or organ of the digestive apparatus perform perfectly that function allotted to it in the animal mechanism. Hence, when the teeth become worn and irregular or in any way affected so that *mastication* is imperfect, an imperfect digestion will be the result. This imperfectly digested food accumulates in the stomach, abnormal fermentation sets in, which is followed by bloat and in many instances death.

Saliva—A horse will secrete about ten pounds of saliva per day. This quantity, however, will vary between moist soft, and dry food; being greater when the animal is fed for some time on a dry food. It is very important that saliva should be secreted in sufficient quantity to moisten the food, otherwise digestion will be seriously impaired. Hence, when we change from a soft food, where a small quantity of saliva is needed, to a dry food, the animal cannot at once furnish the amount required.

A good remedy and one that can be had at any drug store, is one ounce of Muriate of Ammonia in water, given at short intervals for a few hours. Should this fail, as it often does in severe cases, puncture of the stomach should be resorted to.

Prevention, in this, as in all other cases where possible, is a much safer course than the risk of cure when once affected. To avoid this we should be careful about the change of food, guarding against a sudden change from a soft to a dry food.

In cattle the food passes from the mouth to the second stomach, and from here to the first stomach. Should there be too much soft food, such as clover, taken into the second stomach, fermentation may set up before the food has been returned to the first, giving rise to what is commonly known as "clover bloat." For such cases of bloat, punc-

ture is the best remedy. Common soda or Muriate of Ammonia may be used with good effect. If puncture has been resorted to and failed, the food must be taken out of the stomach, by making sufficient opening to allow the hand to pass in. This operation requires some skill and knowledge of the anatomy of the animal to be advisable.

Coarse dry, hard food is the most dangerous of foods, and is much more apt to cause bloat than the soft food, and should be used with great care.

GLANDERS.

As we have some cases of this disease in our community, it may be well to say a few words in regard to the nature of the disease. Many have been seriously alarmed at the disease, fearing that it might soon extend its ravages into every barnyard. There is no occasion for this fear as it spreads slowly, and as a contagion, by contact, or near approach. Many people have an idea that distemper turns into glanders, which is a mistake as the diseases are quite different; one lasting for a few months while the other may continue for several years. Again, the swelling under the throat is much larger in cases of distemper than in glanders, and usually bursts while in glanders it is hard and never bursts. Mules, when attacked by glanders seldom live more than three or four months, while horses may live three or four years with it.

Catarrh is sometimes mistaken for glanders, but there is no need for confounding the two, as there is no swelling under the throat in case of catarrh, besides there is a difference in the color and consistency of the discharges from the nostrils.

Dr. McNulty: What do you think of the signs of the *zodiac* on animal life?

Ans.: I know of no influence such signs could have.

Mr. Leonard: We are troubled with black-leg in our community, tell us something about it.

Ans.: While in France I saw them vaccinate against this disease, but as it is new practice I cannot say what will be the outcome. Medicine is of little value in the treatment of this disease. Antiseptics are used to some extent, and are advantageous in many ways. The disease has not been sufficiently studied to give much information on the subject. The study of this and kindred diseases has been sadly neglected in this country, and as a result we have no means of prevention or cure.

Judge Boulton: Is it contagious?

Ans.: It is not transmitted from one animal to another, but the same cause will produce the same effect on different individuals.

Dr. McNulty: I have heard that poor animals do not take it.

Ans.: I have noticed that *fat* animals are affected most. As the disease is due to a germ, in order to give the reason for fat animals being attacked most, we would have to assume that the germ finds a more productive soil and congenial clime in a fat animal, than in its poverty stricken neighbor. In Germany an experiment of vaccinating in the jugular vein has been made, but such a system is impracticable. A change of pasture will often prevent those unaffected from taking it.

Dr. McNulty: Has it any climatic range.

Ans.: It is found on both continents.

Mr. Shepard: I knew a gentleman in Saline county who bought a calf with black-leg to drive, claiming that the exercise of driving would cure it, according to his experience. I have had them to get well.

Ans.: Yes, they sometimes recover, but as often without medicine as with.

Mr. Leonard, of Saline county, was called upon, and in response he said that he regretted to say that he had not prepared a paper as was his duty as a member of the Board. He also stated that he had been a farmer all of his life, and never expected to follow anything else. Promised to come better prepared on the next occasion. He spoke of the things that were sources of discouragement to the farmer. But *ignorance* is worse than all others combined, and has wrought more evils to the farmer than the cut worms, drought, cyclones, black-leg, pleuro pneumenia, etc.

Mr. ———: Tell us about hog cholera.

Dr. Paquin spoke of the germ theory, its origin in France, where they vaccinate against hog cholera, being opperated successfully in Germany also. We have more than one disease that goes under the name of hog cholera, and in Germany one form is not effected by vaccination.

Mr. Russell: Will the blood of a dying hog put in the blood of another kill it?

Ans.: Yes, at once.

Dr. McNulty: I had 150 sheep on my farm some years ago, and all got very fat. The next year they did not do well and I could not find a mutton among them. We killed and examined one, and found the intestines almost covered with little green knots or tumors about the size of a pea. None died.

Dr. Paquin: This was due to a parasite, which is peculiar to wet places. A physic is sufficient remedy.

Dr. McNulty introduced the subject of poultry diseases and said: "I found a poultry house on my farm when I came here, and for several

years nearly all of my fowls died. I destroyed the building, built a new one, and kept it disinfected with carbolic acid and have had no trouble since. I advocate building a new house for poultry every two or three years."

Dr. Paquin: Disinfectants must be used to destroy the germs of disease and I recommend sulphurous acid in place of carbolic acid, the former is cheaper, and being in a gaseous form will naturally distribute itself more evenly than a liquid; besides carbolic acid will not kill all germs. Corrosive sublimate is effective but dangerous to use. Hot water, when practicable, is good and will kill all germs if heated sufficiently. Disinfectants. he said, were our best preventatives.

Mr. Cowan was called upon for his views on sanitary regulations. He said that he was in favor of the enactment and most rigid enforcement of such laws as were necessary to stamp out every germ of these contagious and infectious diseases—that so long as we fostered the germs of disease, it was foolishness to undertake the eradication of the disease, etc.

Dr. Laws was called for and responded by referring in a brief manner to the work of the vaccine laboratory. He asked why we should not do the work right here that eminent men are doing abroad. This is a critical work, requiring both intelligence and executive ability, yet we have the material in our midst but we lack the money. We need a public interest awakened and a more liberal action of the Legislature, in short, we need the steam required to propel the machinery.

Judge Boulton: I wish every farmer in Boone county could be made to feel as I do, and to realize more fully that we have everything at hand that is necessary for our use and education. Our President now lends, as he always has, his influence toward the upbuilding of the Agricultural School. We should, therefore, claim of the State that support and patronage it so well deserves, and from the Legislature sufficient means to supply the needs of the institution.

Dr. McNulty: I have one word to say regarding the means to raise steam for this work. We need a little education for our representatives. They have too much demagogy and not enough principle. Before we can have a Legislature that will do right by this work, we have got to adhere less closely to party. We elect, if nominated, ignorant, brutal and narrow minded men in preference to a model man in all that the term means, if he should not be the nominee of the party in power. These young men should now divest themselves of the passions of politics and vote for intellect, character, energy, and modern men. If the money expended annually for drink by the voters of Missouri should be given to this institution it would readily supply every need.

On motion of Mr. Doud, it was voted that the Board adjourn the public meeting and go into a business session.

BUSINESS SESSION.

The committee appointed at a previous session to settle with the Treasurer, begged to make the following report, which was received and the committee discharged:

Your committee appointed to settle with the Treasurer of this Board has gone over the vouchers and papers and make this their report:

We find cash on hand, Nov. 4, 1885	$1,999 62
Cash drawn from the State Treasurer, April 16, 1886	2,500 00
Sept. 28, 1886, cash drawn back from Tribune Prtg. Co	200 00
Total	$4,699 62
We find the amount paid out as per bills and vouchers	2,889 17
Cash on hand to date	$1,810 45

Signed: M. FAIRCHILDS DOUD,
A. LEONARD.
Committee.

Dr. Laws remarked that the Board was in better condition financially than he expected to find it, and enquired of the Secretary if he could give the demands upon the Board that would likely be made.

The Secretary replied that this amount on hand had been held back by the most rigid economy to meet the expense of distributing 14,000 copies of the report which is now about to go to press. This will cost about $1,000, as the law requires its distribution, also the Board has $150 in obligations for montly crop reports. It will require $700 to defray the expenses of the Farmer's Meetings and $250 for clerk hire. To this will have to added incidental expenses, although this particular bill of cost was about nothing, as the Board had no rent to pay and no charges were made for the lights and fuel furnished.

Moved by Mr. Doud, that the Missouri State Board of Agriculture hold a Fat Stock Show in the autumn of 1887.

Mr. Sanborn suggested an amendment to the motion to the effect that we invite the co-operation of the Kansas City Fat Stock Show Association and the Kansas State Board of Agriculture.

Dr. Laws suggested the following:

Resolved, That the Missouri Board of Agriculture will join with other parties in holding a national fat stock show in the fall of 1887, provided the means for doing so be available and sufficient inducements be offered, at some eligible point in this State. Adopted.

Moved by Mr. Rippey, that $525 be asked for the premiums on corn, tile drainage tests and early maturity of pigs, to be divided as follows: $100 for first, $50 for second, and $25 for third, for each purpose, the Secretary to furnish rules governing the contest. Voted.

Moved by Mr. Rippey, that the number of members of this Board be increased to fourteen.

Mr. Doud moved that an amendment be made, raising the number to thirty-four, or one from each State Senatorial district. After much discussion this amendment was withdrawn, and Mr. Rippey's motion carried; after which the Board adjourned until 7:30 P. M.

EVENING SESSION.

Met in the University chapel according to adjournment.

The first speaker introduced was Prof. Tracy, of the Missouri Agricultural College, who treated the subject of oleomargarine, of which only a brief outline can be given here.

He said that oleomargarine was not soap-grease nor axle-grease, as many supposed, but was made from the best portions of the animals, and in its manufacture the utmost care is exercised.

The following is the average chemical composition of oleomargarine compared with butter:

	Butter.	Oleomargarine
Water	11.96 per cent.	11.20
Solids	88.03 "	88.79

The solid matter having the following composition :

	Butter.	Oleomargarine
Insoluble fats	75.24	81.19
Soluble fats	7.43	1.92
Casein	.19	.62
Salt	5.16	5.16
Color	trace.	trace.

It will be seen from this table that the composition of the two is almost identical, except in the amount of soluble fats, the butter having a much higher proportion, which furnishes a ready means for the detection of oleo when sold for butter.

That flavor peculiar to good butter is also lacking in oleomargarine but rancid butter, and in fact, much of the butter made in Missouri, is no better than oleomargarine.

The speaker then described the method of making oleomargarine, which we give below.

The present process for the manufacture of oleomargarine is sub stantially as follows:

The selected fat is cut in small pieces and thrown into a vat of warm water where it is soaked for about an hour, after which it is carefully inspected and all inferior pieces are thrown out and used for the manufacture of tallow. The pieces rich in fat are placed in a second vat and after soaking are again inspected and receive a third washing. The selected pieces of fat are then run through a disintegrating machine somewhat like an immense sausage grinder where it is cut and torn into as small pieces as posible. The fat is then placed in a tank which is surrounded by a hot water jacket so that the heat may be kept perfectly regulated, and is rendered at a temperature of from 114 degrees to 116 degrees. It remains in this vat about an hour and a half and is kept constantly agitated so that it may be evenly heated, and about five per cent of salt is added to facilitate the separation of the scrap. When completely rendered, cold water is run into the jacket and the scrap is allowed to settle for half an hour when the fat is drawn off into other vats where it is kept for two or three hours at a temperature of about 120 degrees to complete the seperation of fat and scrap. The clear fat is then taken to the cooling room where it remains for about two days, at a temperature of 85 degrees. The next

step is the separation of the so-called "oleo oil" from the stearine, which is effected by placing the fat in racks and subjecting it to a pressure of about three thousand pounds to the square inch, and this pressure is continued as long as the oil continues to flow. This oleo oil may be kept an indefinite time and is largely exported to Europe. When treated in this way one hundred pounds of beef fat will yield

Oleo oil about 34 pounds.

Tallow about 28 pounds.

Stearine about 10 pounds.

Scrap about 25 pounds.

Waste about 8 pounds.

In the manufacture of oleomargarine it is the common practice to use about

442 pounds oleo oil.

120 pounds fresh milk.

37½ pounds fresh butter.

1¼ oz soda-bicarbonate.

The necessary amount of some harmless coloring matter, usually arnotto, is also added and the whole in then warmed sufficiently to melt the fat and is churned for five or ten minutes. It is then drawn from the churn into large boxes containing pounded ice in order to cool it as rapidly as possible. After becoming thoroughly cooled it is salted and worked like ordinary butter and is then ready for market.

The amount of oleomargarine made and sold in the country per year, is estimated to be about 200,000,000 pounds.

In Holland, the dealers in this article are required by law (and the law is enforced) to mark plainly every package, and yet, it is used more freely there than in any other country. (Is it used or is it shipped as adulterated butter and sold as pure butter? Sec'y.)

Oleomargarine will not retain its original flavor as long as good butter, but the oleo-oil, the base for oleomargarine can be kept fresh for an indefinite time, and the bulk of oleomargarine that is transported is in this form.

Since the first invention of this article in 1879, down to the present day it has been used largely by unscrupulous dealers to either adulterate pure butter with or sold as pure butter without being adulterated. This has given rise to many tests, looking toward the sure and speedy detection of oleo, in cases of either adulteration or imitation.

Many of these tests, however, have been crude, and as fast as they were devised and accepted, that fast have the oleo manufacturers changed the proportion of their product to evade them, and have thus far perhaps been successful.

A chemical test can always be relied upon, and Dr. Taylor's test of the crystalization of fat as shown under the microscope is almost universally accepted as an infallible test. The speaker then showed by diagrams on the blackboard the various forms of crystals, both of oleo. and butter. Butter when fresh shows the "St. Andrew's Cross."

This method, as put forth by the Department of Agriculture at Washington, is disputed by Prof. Weber, of Ohio, but I have gone very carefully over the experiments described by Prof. Weber as proving the infallibility of the above test and have found nothing to shake my faith in the test.

Oleomargarine can be sold at present at about sixteen cents per pound and will chiefly affect the poorer grades of butter but will never compete with good butter to any extent.

M. F. Doud, Esq., then read a paper which will be found in the body of this report.

The next exercise was a paper by Prof. Taft, of Missouri Agricultural College, which will also be found in the body of this report.

The President, after thanking the audience for their presence and kind attention, declared the house adjourned.

BUSINESS SESSION.

Mr. Potts in the chair.

The Committee on Resolutions concerning the death of Hon. H. Eshbaugh submitted by Mr. Doud, the following report, which, on motion of Mr. Cowan, was received and adopted:

WHEREAS, It has pleased kind Providence, the Ruler of the Universe, to strike down one of our best members and the chief executive of this Board, Hon. H. Eshbaugh, by death; and,

WHEREAS, The deceased led a life of devotion to farming, and unselfishly and earnestly labored to elevate the farmer's work and life, and to place agriculture on a higher plane; and,

WHEREAS, The deceased was perhaps more widely known among farmers than any of his co-workers, extending to the further confines of this country through his broad and generous labors as Master of the National Grange; and,

WHEREAS, Mr. Eshbaugh was an active and valuable worker in this Board or Agriculture, his labors making an impress upon our agriculture that will live on; therefore, be it

Resolved, That this Board expresses its deepest sorrow over the death of so valuable a member, and its warmest sympathies for the bereaved family of the deceased; and, be it further

Resolved, That a copy of these resolutions be made and forwarded by the Secretary to the family of the deceased.

Moved by Mr. Doud, that the Secretary be authorized to hold farmer's institute meetings not to exceed $700 in cost, and to employ such aid as he deems best. Carried.

Moved by Mr. Cowan, that we recommend to the General Assembly the propriety of discontinuing the publication of the German report, this action to be at the discretion of the Secretary.

On motion of Mr. Rippey, it was voted that the Secretary be authorized to condense any matter presented to the Board that he may deem proper.

Mr. Cowan heartily favored the resolution.

On motion of Mr. Doud, it was voted that we hereby endorse the action of the Congress of U. S. in the passage of the law regulating the sale of oleomargarine.

Moved by Mr. Doud, that the following appropriations be asked for:

Three thousand dollars yearly for crop reports, distribution of report of Board, institute meeting, prizes for crops, drainage, etc., and for general expenses; also $1,500 for a clerk for the office, and $3,000 for Fat Stock Show.

Moved by Mr. Cowan, that the second item be amended by inserting at $1,200. Passed as amended.

Moved that $3,000 for general expenses be asked. Voted.

Moved that item for Fat Stock Show of $3,000 be amended to $2,500. Adopted.

Moved that the State be asked to extend the work of assessors so as to include further agricultural products. Voted.

Moved by Mr. Doud, that the General Assembly be asked to have 7,000 copies of the annual report bound in cloth. Voted.

Moved by the Secretary, that two delegates be appointed to attend the National Cattle Growers convention at Chicago. Carried.

The chair appointed Prof. Sanborn and Mr. Leonard to constitute this committee.

Moved by Mr. Doud, that each member be authorized to raise money for any of the premiums. Carried.

Moved by Mr. Cowan, that in case of no competition, the second premium be given also. Withdrawn.

On motion of Mr. Rippey, it was voted that the Secretary be authorized to arrange these premiums.

The motion of Mr. Doud concerning passes from railroads was called up.

The motion was that a committee be appointed to consult the various railroads and secure passes for the members.

Mr. Leonard favored the motion as it would save the Board much expense.

Mr. Rippey said there was an element in this State which was opposed to passes, and he was afraid it would be a dangerous move.

Moved by Dr. Laws, that the attention of Horticultural Societies be directed to the law. Voted.

Moved that the Secretary of the Board be requested to call the attention of the Secretaries of Agricultural and Mechanical Societies to the law. Passed.

Moved by Mr. Doud, that portraits of Hon. John Walker and Hon H. Eshbaugh, together with biographical sketches of their lives be inserted in the next report, provided, they be furnished free. Carried.

Motion to adopt the report of the Secretary, called up and passed.

Moved by Mr. Doud, that we now proceed to the election of officers. Carried.

Dr. Laws nominated Mr. A. Leonard, saying that his location and active life as a farmer made him an available man.

Mr. Cowan said that he was about to put in nomination Dr. Laws.

Dr. Laws said that he was loaded down to the guards with work, besides he did not think he was fitted for the position; he could not take it, at any rate.

On first ballot the vote stood five for Dr. Laws, two for A. Leonard, Esq., and one for J. A. Potts, Esq.; Dr. Laws positively declined, expressing his thanks for the vote; a second ballot was taken without choice, Mr. Leonard withdrawing in favor of Mr. Potts; a third ballot was taken giving six for Mr. Potts, and two for Mr. Leonard; Mr. Potts was then declared elected.

Ballot for Vice-president was next taken, giving six for Mr. Leonard and two for Mr. Cowan.

Mr. Leonard was declared Vice-president.

Secretary was next balloted for, with result of six ballots, all for J. W. Sanborn.

J. W. Sanborn was declared elected.

The Treasurer was voted for and S. M. Tracy was unanimously elected.

The Board then adjourned *sine die.*

J. W. SANBORN, Secretary.

VALUABLE TABLES.

The following tables were made by T. C. Thomas, C. E., while assisting the Secretary, and from material mostly furnished by the Secretary. The first two or three pages were furnished by Mr. Thomas, and all of the matter was carefully and thoughtfully organized into tables, by him, with accompanying notes. Mr. Thomas is a careful, competent man.

The tables covering crop distances of planting, method of seeding potatoes, the Secretary ventures to suggest that enough data are now accumulating to warrant a more decisive opinion upon these questions than man has heretofore been entitled to express. I think the tables referred to in this connection are of great value to our farmers. Ten years of special investigation in seeding of potatoes, a term longer than I know of being covered on this subject by any other experimenter, warrants me in asking farmers to plant upon the data of the table on this subject in full assurance of being right. This question involves a great saving to our State, and, contrary to my usual custom, I urge farmers to accept as conclusive for them these tables on method of cutting potatoes, so far as the systems tried are concerned.

These tables on crop distances, etc., are the average of critical trials by competent parties, usually by experiment tables, hence they are reliable. Most of the results I have confirmed in trials. The tables of averages for the animals winning prizes at the Kansas City and at the American Fat Stock Shows has been the result of much labor, and contains data that will bear much study from several standpoints. This table should have each annual result embodied until its teachings become unequivocal, being sealed by strength of great numbers.

HANDY RULES AND TABLES.

THE STANDARD BUSHEL.—A standard bushel is a measure eight inches deep and eighteen and a half inches inside diameter, containing 2,150 cubic inches. The heaped bushel requires six inches in the height

of the cone above the top of the stroked bushel, and contains 2,748 cubic inches in all.

CONTENTS OF CRIBS.—Multiply together the length, breadth and height in feet, to get the contents in cubic feet; multiply this by four, and strike off the right hand figure. The result will be the number of bushels of shelled corn in the crib, very nearly.

When the crib is wider at the top than bottom, multiply the half sum of the top and bottom breadths by height, this product by the length, and proceed as before. The following table based on the supposition that the crib is ten feet high, and that 3,840 cubic inches, or 1.4 heaped bushels of corn in the ear will make one stroked bushel of shelled corn, gives the contents in bushels, of cribs of various lengths and breadths:

TABLE FOR CALCULATING THE CAPACITY OF CRIBS, BINS, ETC.

Breadth.	Length.																		
	7	8	9	10	11	12	13	14	15	16	18	20	22	24	26	28	30	32	34
3	94	108	122	135	149	162	175	189	202	216	243	270	297	324	351	378	405	432	459
4	126	144	162	180	198	216	234	252	270	288	324	360	396	432	468	504	540	576	612
5	158	180	202	225	248	270	292	315	337	360	405	450	495	540	585	630	675	720	765
6	189	216	243	270	297	324	351	378	405	432	486	540	594	648	702	756	810	864	918
7	220	251	283	315	347	378	409	441	472	504	567	630	693	756	819	882	945	1,008	1,071
8	252	288	324	360	396	432	468	504	540	576	648	720	792	864	936	1,008	1,080	1,150	1,222
9	284	324	364	405	446	486	526	567	607	648	729	810	891	972	1,053	1,134	1,215	1,296	1,377
10	315	360	405	450	495	540	585	630	675	720	810	900	990	1,080	1,170	1,260	1,350	1,440	1,530
11	346	396	446	495	545	594	643	692	742	791	891	990	1,089	1,188	1,287	1,386	1,485	1,584	1,683
12	378	432	486	540	594	648	702	756	810	864	972	1,080	1,188	1,296	1,404	1,512	1,620	1,728	1,836
14	441	504	567	630	693	756	819	882	945	1,008	1,134	1,260	1,386	1,512	1,638	1,764	1,890	2,016	2,142

For a crib of any other height than ten feet, take from the table the number corresponding to the actual length and breadth of the crib and multiply one-tenth of this by the actual height of the crib. The contents of a crib of a length or breadth not given in the table, may be found on the same principle.

THE MISSOURI RULE.—In Missouri corn is generally estimated in barrels, five bushels being allowed to the barrel. The rule commonly used is:

Multiply together the length, breadth and height expressed in inches, and divide the product by 19,008. The result will be the contents of the crib in barrels, which multiplied by five will give the contents in bushels. When corn is cribbed in the husk, it is customary to take one-fifth from the result obtained as above (T. C. T.) This rule gives results essentially the same as the preceding table; this allowing 3,802 cubic inches of corn in the ear to the bushel of shelled corn, while that allows 3,840 cubic inches. The foregoing rules are of course applicable to boxes and wagon-beds.

CONTENTS OF RECTANGULAR BINS, GRANARIES, ETC.—Multiply together the length, breadth and height expressed in feet; multiply this by 56, and divide by 45. The result will be the contents in stroked bushels, or:

Multiply together the length, breadth and height, expressed in inches, and divide by 2,150, or by 2,748, and the quotient will be the contents in bushels; stroked, for the former divisor, and heaped, for the latter.

MEASUREMENT OF HAY IN THE MOW.

Multiply together the length, breadth and height, expressed in feet, and divide by 450; the result will be the weight of the hay expressed in tons. The above will give but a rude approximation depending upon the assumption that 450 cubic feet of hay will weigh a ton, and it is evident that this assumption will often be incorrect.

MEASUREMENT OF HAY IN THE STACK.

Divide the square of the mean of the circumferences of stack at the base and the bulge by 12,566, and multiply this by the height of stack to the bulge; add to this the result obtained by dividing the square of the circumference at the bulge by 12,566 and multiplying this by one-third of the height of top of stack above the bulge. The sum, divided by 450, will give the weight of hay in tons. All the dimensions of the stack should be expressed in feet.

CONTENTS OF CISTERNS.—"Thirty-six inches of rain per year will yield seventy-two barrels of water for each ten feet square (100 square feet of roof). Thus, a 30x40 barn may supply two barrels per day throughout the year. Hence, in dry countries, that is countries where heavy rains are succeeded by long droughts, the cisterns must be larger than in those countries where rains are more constant, or, in countries having an average fall of water. When the water is to be used daily, a 30x40 barn should have a cistern ten feet in diameter and nine feet deep; this will hold 168 barrels. But, if to be drawn from only in time of drouth, it should be three times this capacity. To determine the contents of a circular cistern of equal size at top and bottom, square the diameter in inches, multiply the square by .0034 and this by the depth in inches; the result will be the contents in gallons, which, divided by 31.5, will give the contents in barrels.

The following table gives the contents of cisterns of various depths and a diameter of ten feet:

Depth, feet.	Contents, barrels.	Depth, feet.	Contents, barrels.	Depth, feet.	Contents, barrels.	Depth, feet.	Contents, barrels.
5	93.2	9	167.8	13	242 4	17	317.0
6	111.8	10	186.5	14	261.1	18	335.7
7	130.5	11	205.1	15	279.7	20	373.0
8	149.1	12	223.8	16	298.4	22	410.3

For a cistern of a diameter other than ten feet, take from the table the number corresponding to depth of cistern in question, strike off the two right hand figures and multiply by the square of the actual diameter. The contents of a square cistern in gallons, is equal to the product of its length, breadth and depth, all expressed in inches, divided by 231.

TABLE OF INTEREST AT SIX PER CENT.

The amounts at interest are placed at the head of the columns, the time for which interest runs, in the left hand column. The interest will be found under its principal and opposite its time to run.

For any other rate of interest, divide the interest given in the table by six, and multiply by the desired rate. The interest for any time not given in the table may be found by adding the interests for such times as added together will give the required time; and on the same principle may be found the interest for an amount not given in the table.

Time.	1	2	3	4	5	6	7	8	9	10	20	30	40	50	60	70	80	90	100	1,000
1 day	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	2	2	17
2 days	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	2	3	3	3	33
3 "	0	0	0	0	0	0	0	0	0	1	1	2	2	3	3	4	4	5	5	50
4 "	0	0	0	0	0	0	0	1	1	1	1	2	3	3	4	5	5	6	7	67
5 "	0	0	0	0	0	1	1	1	1	1	2	3	3	4	5	6	7	8	8	83
6 "	0	0	0	0	1	1	1	1	1	1	2	3	4	5	6	7	8	9	10	1 00
7 "	0	0	0	0	1	1	1	1	1	1	2	4	5	6	7	8	9	11	12	1 17
8 "	0	0	0	1	1	1	1	1	1	1	3	4	5	7	8	9	11	12	13	1 33
9 "	0	0	0	1	1	1	1	1	1	2	3	5	6	8	9	11	12	14	15	1 50
10 "	0	0	1	1	1	1	1	1	2	2	3	5	7	8	10	12	13	15	17	1 67
20 "	0	1	1	1	2	2	2	3	3	3	7	10	13	17	20	23	27	30	33	3 33
1 month	1	1	2	2	3	3	4	4	5	5	10	15	20	25	30	35	40	45	50	5 00
2 months	1	2	3	4	5	6	7	8	9	10	20	30	40	50	60	70	80	90	1 00	10 00
3 "	2	3	5	6	8	9	11	12	14	15	30	45	60	75	90	1 05	1 20	1 35	1 50	15 00
4 "	2	4	6	8	10	12	14	16	18	20	40	60	80	1 00	1 20	1 40	1 60	1 80	2 00	20 00
5 "	3	5	8	10	13	15	18	20	23	25	50	75	1 00	1 25	1 50	1 75	2 00	2 25	2 50	25 00
6 "	3	6	9	12	15	18	21	24	27	30	60	90	1 20	1 50	1 80	2 10	2 40	2 70	3 00	30 00
7 "	4	7	11	14	18	21	25	28	32	35	70	1 05	1 40	1 75	2 10	2 45	2 80	3 15	3 50	35 00
8 "	4	8	12	16	20	24	28	32	36	40	80	1 20	1 60	2 00	2 40	2 80	3 20	3 60	4 00	40 00
9 "	5	9	14	18	23	27	32	36	41	45	90	1 35	1 80	2 25	2 70	3 15	3 60	4 05	4 50	45 00
10 "	5	10	16	20	25	30	35	40	45	50	1 00	1 50	2 00	2 50	3 00	3 50	4 00	4 50	5 00	50 00
11 "	6	11	17	22	28	33	39	44	50	55	1 10	1 65	2 20	2 75	3 30	3 85	4 40	4 95	5 50	55 00
1 year	6	12	18	24	30	36	42	48	54	60	1 20	1 80	2 40	3 00	3 60	4 20	4 80	5 40	6 00	60 00

AGE OF HORSES AS INDICATED BY THE TEETH.

The teeth of a horse, when full-mouthed, are forty in number, and are divided into incisors or nippers, tushes or canines, and molars or grinders. The incisors are twelve in number, six in each jaw, and occupy the front of the mouth. For convenience of description they are divided into pairs: the central, the dividers and the corner nippers. These teeth furnish the principal indications of age. The tushes are back of, and next to, the incisors, four in number, one above and one below on each side. They are generally rudimentary in the mare, seldom appearing above the gums.

The grinders occupy the back part of the mouth, and are twenty-four in number, twelve above and twelve below. The horse has two sets of teeth; temporary or milk teeth, and permanent teeth. All these teeth are covered with an enamel which spreads over the portion of the teeth above the gum, passes over the upper surface of the teeth, is bent inward and sunk into the body of the teeth, forming a little pit in them. The inside and bottom of this pit being blackened by the food, constitute the *mark* in the teeth, by the gradual disappearance of which, in consequence of the wearing down of the teeth, we are enabled for several years to judge of the age of the animal.

AT ONE YEAR.—The four middle teeth are worn almost level. The mark in the two middle teeth is wide and faint, in the next two teeth it is longer, darker, and more narrow. At this age, or soon after, the colt has six nippers and four grinders in each jaw.

AT TWO YEARS.—The mark in the central nippers will be much shorter and fainter, that in the two other pair will have undergone an evident change; all the nippers will be flat. About this time a fifth grinder will appear. At two and a half years the milk teeth begin to shed and the permanent to appear.

AT THREE YEARS.—The central teeth (permanent) are larger but lower than the other nippers (milk teeth). The mark in the next two nippers is nearly worn out and it is wearing away in the corner nippers.

AT FOUR YEARS.—The central nipper will be fully developed, the mark shorter, wider and fainter. The next pair (permanent) will be up, but they will be small, with the mark deep and wide extending quite across them. The sixth grinders will have risen to a level with the others, and the tushes will begin to appear.

AT FIVE YEARS.—The nipper are worn down on both edges until the mark is nearly gone. The corner nippers (permanent) are quite up. The tush is much grown. The sixth molar is quite up, and the

third molar is wanting. The last three grinders and the tushes are never shed.

AT SIX YEARS.—The mark on the central nippers is worn out, though there will always be a brownish spot and a slight depression in the center of the tooth. The tush has attained its full growth, and the third grinder is fairly up. The horse is now full mouthed, all the teeth being present, and full grown.

AT SEVEN YEARS.—The mark is worn away in the four central nippers and is fast wearing away in the corner nippers. The pointed ends of the hook teeth have become more rounded, and are worn away somewhat.

AT EIGHT YEARS.—The tush is rounder in every way. The mark is gone from all the nippers of the lower jaw, and it may almost be said to be out of the mouth. Nothing remains in the lower nippers to show conclusively the age.

After the age of eight years the age connot be determined with any certainty by the teeth. In determining age by the teeth the lower jaw should be examined in preference to the upper.

And indication of the age is also given by the shape of the top of the nippers, thus: The top of the nippers is a transverse oval at from six to twelve, round from twelve to eighteen, three cornered from eighteen to twenty-three, and a longitudinal oval at twenty-four years. But these indications cannot be implicitly received.

The foregoing matter has been largely drawn from Dr. Jenning's valuable work on *The Horse and his Diseases*.

THICK AND THIN SEEDING OF CORN.

The following tables are intended to exhibit the more important results of all the available experiments that have been made on the effect of planting corn at various distances, and of varying the number of plants to the hill:

TABLE I.

EFFECT OF VARYING THE DISTANCE BETWEEN THE HILLS.

Plants per acre.	Distance apart.	No. in hill.	Bushels per acre.	Lbs. of stalks per acre.	Per cent. of ears.	Per cent. of nubs.	Remarks.
24,890	* 6	1	49.1	6,140	14.8	85.2	Authority—Reports of Ohio Experiment Station for 1882–83–84.
12,445	12	1	66.4	4,557	40.5	59.5	
9,956	15	1	66.1	4,398	56.5	43.5	
8,297	18	1	63.3	3,793	70.5	29.5	
7,111	21	1	60.9	3,657	76.0	24.0	
6,222	24	1	55.3	3,026	79.7	19.2	
24,890	12	2	62.4	5,259	27.0	73.0	
19,912	15	2	75.0	5,201	.....	.....	
16,594	18	2	65.7	5,118	34.4	65.2	
14,222	21	2	61.1	4,083	.....	.....	
12,445	24	2	61.8	3,941	47.2	52.8	
9,956	30	2	59.6	3,639	59.0	41.0	
24,890	18	3	50.4	5,383	20.1	79.9	
18,666	24	3	52.0	4,328	25.0	75.0	
14,934	30	3	53.1	3,980	26.9	73.1	
12,445	36	3	55.4	3,715	33.6	66.4	

* Plants in drills 3½ feet apart.

The above table contains the means of the results of three years' experiments at the Ohio Agricultural Experiment Station, and points to the following conclusions:

The yield of corn increases as the distance between the hills increases, to a certain point beyond which it decreases as this distance increases.

The percentage of ears increases as the distance increases.

The weight of stalks decreases as the distance increases.

The results given below were obtained in 1882 and '83, at the New York Agricultural Experiment Station, from plats one-twentieth of an acre in area and fertilized with 400 pounds of super-phosphates per acre.

TABLE II.

(Results for 1882.)

Distance between hills.	Yield per acre, bushels.			Per cent. of good corn.
	Good.	Poor.	Total.	
1 x1 foot.	5.8	11.0	16.8	34
2 x2 feet.	7.0	11.6	18.6	38
3 x2 "	39.1	9.8	48.9	80
3 x3 "	48.7	12.8	61.5	79
3½x3⅔ "	49.7	1.5	51.2	97
4 x5 "	35.9	2.5	38.4	93
5 x5 "	19.0	2.9	21.9	87

Four plants per hill.

TABLE III.

(Results for 1883.)

Distance between hills.	Yield per acre, bushels.	Plants per hill.
24x24 inches.	28.5	4
21x44 "	45.5	4
42x44 "	49.5	4
44x84 "	30.8	4

Tables II. and III. verify the first of the above conclusions.

While in table II. the per cent. of good corn does not uniformly increase with the distance, yet it seems to tend in that direction.

Following are the results of experiments at Purdue University in 1885:

TABLE IV.

Distance between hills.	No. in hill.	Bushels corn.	Lbs. of stalks.
48x10 inches.	1	70.48	3,038
48x12 "	1	70.54	3,212
48x14 "	1	67.17	2,914
48x16 "	1	59.83	2,709
48x20 "	2	69.52	3,168
48x24 "	2	69.52	3,114
48x28 "	2	61.77	2,847
48x32 "	2	58.21	2,474
48x30 "	3	72.57	3,292
48x36 "	3	71.68	3,007
48x42 "	3	65.71	2,634
48x48 "	3	59.74	2,527

This table serves still further to verify the first deduction from table I. The weight of stalks, with one exception, decreases as the distance increases, agreeing closely with the third of the foregoing conclusions.

TABLE V.

THICKNESS OF PLANTING IN HILL.

[From reports of N. Y. Exp. Sta., 1884 and 1885.]

No. of plants per acre.	No. in hill.	Bushels per acre.	No of ears per plant—sound corn.	Weight per ear—sound corn.	Weight per plant—sound corn.	Distance between hills.
3,394	1	48.5	3.25	5.533 oz.	1.11 lbs.	42x44 inches.
6,788	2	58.7	1.85	5.535 "	0.66 "	42x44 "
10,182	3	65.8	1.41	6.017 "	0.54 "	42x44 "
13,576	4	59.2	1.11	5.784 "	0.41 "	42x44 "

Plats fertilized with 400 pounds of phosphate per acre.

TABLE VI.

[From reports of Ohio Exp. Sta., 1882-83-84 and '85, corn in drills 3½ feet apart.]

Plants per acre.	Distance apart.	No. in hill.	Bushels per acre.	Weight of stalks, lbs.	Per cent. of ears.	Per cent. of nubs.	Remarks.
12,445	12 inches.	1	70.8	4,178	50.7	49.3	This table will not agree altogether with Table I., as the results for another year were used in compiling this table.
24,890	12 "	2	66.9	5,016	31.0	69.0	
9,956	15 "	1	66.1	4,398	56.5	43.5	
19,912	15 "	2	75.0	5,201	.....	.....	
8,297	18 "	1	65.4	3,490	70.5	29.5	
16,594	18 "	2	65.7	5,118	34.4	65.6	
24,891	18 "	3	59.8	4,907	27.8	72.2	
7,111	21 "	1	60.9	3,657	76.0	24.0	
14,222	21 "	2	61.1	4,083	....	.....	
6,222	24 "	1	55.3	3,026	80.8	19.2	
12,445	24 "	2	72.7	3,801	55.8	44.2	
18,666	24 "	3	52.0	4,328	25.0	75.0	
9,956	30 "	2	59.6	3,639	59.0	41.0	
14,934	30 "	3	53.1	3,980	26.9	73.1	

By table V. the number of ears per plant decreases as the number of plants per hill is increased, while the weight of ears becomes greater as this number increases until there are three plants to the hill, when the weight begins to decrease. But the yield of each plant is seen to diminish throughout as the number of plants per hill is increased. The yield per acre increases until there are three plants to the hill and then decreases.

In table VI. the greatest yields are, with one exception, from two plants to the hill, and the percentage of good ears is largely in favor of one stalk to the hill.

With two exceptions the largest weight of stalks is also given by two stalks to the hill. In 1869 and 1870 the Pennsylvania Agricultural College experimented on the relative yield of corn planted one stalk at every foot of distance in the row and that planted three stalks at every three feet of distance in the row. In 1869 the one stalk plats gave a gain of six bushels per acre over the three stalk system, and the next year a gain of two bushels per acre.

The following table gives the yield of plats planted with like numbers of stalks per acre, but variously grouped:

Distance apart.	No. in hill.	Bushels corn.	Pounds of stalks.	Remarks.
36x 6 inches.	1	49.1	6,140	Authority—Ohio Exp. Sta. Reports for 1882 and 1884.
x12 "	2	62.4	5,259	
x18 "	3	50.4	5,383	
36x12 "	1	66.4	4,557	
x24 "	2	61.8	3,941	
x36 "	3	55.4	3,715	
36x15 "	1	66.1	4,398	
x30 "	2	59.6	3,639	
48x10 "	1	70.48	3,038	Authority—Purdue University Bulletin No. 6.
x20 "	2	69.52	3,168	
x30 "	3	72.57	3,292	
48x12 "	1	70.54	3,212	
x24 "	2	69.52	3,114	
x36 "	3	71.68	3,007	
48x16 "	1	59.83	2,709	
x32 "	2	58.21	2,474	
x48 "	3	59.74	2,527	

The results obtained at Purdue show a minimum yield of corn for two plants in the hill throughout, but these are the results of but one year's experiments. In the Ohio experiments two stalks to the hill gave the highest return in one case and the next highest in another, as the mean results of three years' experiments. The experiments do not point clearly to the distance between hills or the number of stalks to the hill, that are calculated to give the greatest yield. They indicate plainly, however, that the quality improves and yield per plant increases as the distance increases. So long as the advantage gained by increased yield per plant overbalances the loss occasioned by the dimished number of plants, the yield per acre will increase as the stand is thinned, after which it will diminish.

For maintaining considerable intervals for the free access of sunlight and air, without diminishing the number of plants per acre, grouping the plants into hills is naturally suggested. What the number per hill

should be is not apparent from the experiments cited, and it is doubtful if a rule can be formulated which will apply to all locaties and seasons. It is evident that grouping cannot be carried beyond a certain point with success.

DEPTH OF PLANTING CORN.

Table I. gives the means of the results of experiments on depth of planting corn, carried on from 1882 to 1885 at the Ohio Agricultural Experiment Station:

TABLE I.

Depth of planting, inches.	Yield of corn.			Per cent.		Weight of stalks.		Per cent.
	Sound, bushels.	Unso'd, bushels.	Total, bushels.	Of ears.	Of nubs.	Per acre, pounds.	Per 100 lbs. corn.	Of perfect stand.
1	63.4	0.5	63.9	56	44	4 795	108.2	94.2
2	52.2	2.0	54.2	52	48	3,604	94.6	98.6
3	49.2	3.3	52 5	56	44	3,013	82.3	83.7
4	45.9	4.1	50.0	53	47	3,255	93.0	79.5
5	38.7	3.7	42.4	44	56	2,830	91.6	78.0

The total yield of corn is seen to decrease and the yield of unsound corn to increase as the depth of planting is increased. The weight of stalks also decreases, with one exception, as the depth increases. The best stand resulted from a depth of two inches, and becomes continually poorer as the depth is increased beyond this. The yields given in the table, both of corn and stalks, are for a perfect stand. The results are decidedly in favor of shallow planting.

In Table II are given the results of two years' (1882 and 1883) experiments at the New York Agricultural Experiment Station. The corn was planted at depths of ½, 1, 2, 3, 4, 5, 6, 7 and 8 inches. In the table the results are grouped as follows: Ordinary planting, or ½, 1 and 2 inches; deep planting, or 3, 4 and 5 inches; very deep planting, or 6, 7 & 8 inches.

Depth of planting.	Pounds of corn per 100 stalks.	Per cent. of perfect stand.
Ordinary planting	35.6	68
Deep planting	36.6	59
Very deep planting	53.5	34

Here is a reversal of the teachings of Table I. so far as yield is concerned; but an agreement as respects per cent. of perfect stand, this percentage diminishing rapidly as the depth increases. The thinner stands for the deeper plantings may explain the larger yields for such plantings, since here the plants had a larger area of soil for occupancy, and better conditions for growth.

Table III embodies the results, as regards corn, of an experiment made at the Michigan Agricultural Farm in 1883. Several varieties of grain were planted in rows six feet long and one and one-half feet apart, at depths varying from one-fourth inch to eight inches.

For corn the results were as follows:

Depth of planting.	Time of		Per cent. of germination	Remarks.
	Planting.	Plant coming up.		
¼ inch	June 4	June 7	100	A heavy rain during after time of planting, washed the ground somewhat.
1 "	" 4	" 9	90	
1½ inches.	" 4	" 9	90	
1¾ "	" 4	" 10	70	
2 "	" 4	" 11	70	
2½ "	" 4	" 11	100	
3 "	" 5	" 13	50	
3½ "	" 5	" 13	80	
4 "	" 5	" 13	90	
5 "	" 7	.....	90	
6 "	" 7	.....	70	
8 "	" 7	.....	80	

In 1880 the following experiment was tried at the Nebraska Agricultural farm: A ditch was dug two feet wide and six feet long, commencing at the surface at one end and sloping to a depth of eight inches at the other. In the ditch were sown one row each of corn, oats, wheat and rye, the grain being planted at every depth from one-half inch to eight inches, The grain covered from one and one-fourth to two inches came up first. That covered at a less depth came up after a shower of rain, that planted at a greater depth came up in regular order as the depth increased. The corn did well at all depths up to four inches, but best at two inches. The crown, or place where the roots grew was from one to one and one-half inches below the surface, and in no case any deeper, however deep the grain was sown. Where the grain was covered deeper there was a root from the seed to the crown. If this distance was great the vigor of the plant was much diminished. If the surface were dry the roots would have to go deeper than in this case; and the best depth for planting would probably be greater than that indicated by the experiment in hand.

YIELDS IN BUSHELS PER ACRE FROM SEED POTATOES VARIOUSLY CUT.

Whole, large.			Whole, small.			Cut seed, more than two eyes.			Two eyes.			One eye.			Remarks.	
Large.	Small.	Total.	Large.	Small.	Total.	Large.	Small.	Total.	Large.	Small	Total.	Large.	Small.	Total.	Locality of experiments.	
.....	.....	265.7	.....	... .	173.0	.....	.....	216.0	.....	.....	139.0	.....	.....	141.0	Ohio experiment Sta.,	1882
229.2	27.4	256.6	75.1	14.1	189.2	199.9	23.3	223.2	179.6	23.1	192.7	136.6	8.6	145.2	" " "	1883
151.2	16.8	168.0	131.0	16.3	137.3	112.7	14.8	127.5	72.2	5.0	77.2	72.8	4.6	77.4	" " "	1884
239.6	106.5	346 1	206.5	59.7	266.2	248.9	80.5	329.4	205.2	35.3	240.5	143·4	10.2	153.6	" " "	1885
.....	.....	349.0	.....	.....	273.2	.....	.....	.....	.....	.....	201.5	.....	.....	136.2	Paris, Ner York.....	1867
182.5	43.5	226.0	123.0	23.0	146.0	235.0	12.7	247.7	132.0	10.0	142.0	113.0	3.0	116.0	Sandy Springs, Md..	1874
															N. H. Agr. Col. Farm.	
119.2	105.8	225.0	127.8	65.1	192.9	105.8	48.4	154.1	83.9	39.9	123.8	60.1	24.9	85.0	Aver. of 4 y'rs experiments	
54.1	58.3	112.4	33.3	31.2	64.5	44.8	16.6	61.4	44.8	14.5	59.3	30.7	10.4	41.1	Mo. Agr. Col. Farm..	1883
185.8	15.0	200.8	172.4	24.0	196.4	.....	.....	.....	.....	.....	.....	.....	.....	.....	Oak Hill, Pa.	
.....	.....	.....	.....	.....	.....	226.0	22.0	248.0	19.2	12.0	204.0	129.0	5.0	134.0	O. Mass , Delano's.	
.....	.....	.....	.....	.....	.....	.....	.....	86.0	.....	.....	.....	.....	.....	82.0	N. Y. Experiment Sta.	1882
222.0	101.0	323.0	.....	.....	.....	193.0	55.0	248.0	.....	.....	.....	148.0	40.0	188.0	" " "	1883

INFLUENCE OF SIZE OF SEED PIECES ON YIELD.

Large pieces, bushels per acre.	Small pieces, bushels per acre.	Place and time of experiments.	Remarks.
82.0	3.9	N. Y. Experiment Sta., 1882	All one-eyed cuts, except last, which is from two and three-eye cuts.
190.1	132.4	" " " 1883	
143.0	54.2	" " " 1885	
76.6	20.7	Houghton Farm.	
126.2	78.8	Wis. Experiment Sta., 1883	
193.7	132.5	Ohio " " 1883	
Mean 135.3	Mean 70.4		

RELATIVE VALUE OF SEED END AND STEM END FOR SEED.

Ratio between yields. Seed end.	Stem end.	Place and time of experiments.	Remarks.
100	65	N. Y. Experiment Sta., 1882	
100	73	" " " 1883	
100	101	" " " 1885	
100	97	Cornell 1879, 1880	
100	87	Ohio Experiment Sta., 1882	
100	76	" " " 1883	
100	91	" " " 1884	
100	94	" " " 1885	
100	133	Wis. " " 1883	
100	111	Paris, New York..... 1874	
100	83	N. H. Agr. College.	Mean of 4 years exps.
100	72	Mo. " " 1883	
100	94	Mass., Delano's.	
Mean 100	Mean 89.4		

NOTES BY THE SECRETARY.

The following tables have been compiled in the Board office by H. J. Waters, B. A. S., who is acting assistant:

The different methods of analysis pursued by the various chemists analyzing the materials in the tables referred to, has prevented the presentation of compact tables of averages according to the original intention.

Again the variation of said analyses from different sources, and the same truth regarding ashes gives a value to these fuller tables that averages could not have. It is hoped that the table of analyses of ashes may induce our farmers who note their great riches to use them with care, as well as to note the variation in value from various sources. Marls and soils have been placed in separate tables for obvious reasons to those who have come to consider the need of soil fertilization. They perhaps might have all, that is soils and marls, been spared from this report. The belief is entertained that many will wish to study them, and that they will have value for reference. Especially, as in former volumes, in this and future volumes will be found tables covering a wide field of inquiry and together valuable for reference.

The table of food analyses is of American crops, and is mainly taken from the report of the Connecticut Experiment Station, Prof. S. W. Johnson director. To this table, however, has been added some later analyses and analyses of fruits, their ash and of other materials of importance. The inquiry of farmers for cheap fertilizer has led to the tables given for lime, plaster, etc, that the true nature of those materials may be seen in the light of former reports.

TABLE I.

Composition of Feeding Stuffs—American Analyses.

Name.	Analyses.....	Total Dry Matter.			Protein.			Fat.			Nitrogen, free ext.			Fibre.			Ash
		Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	
GREEN FODDER.																	
Maize fodder	36	7.10	30.89	18.92	.56	2.72	1.48	.14	.89	.38	3.20	19 69	10.74	1.90	9.78	5.24	1 08
Maize fodder, ensilaged	47	12.32	29.24	19.54	.87	2.77	1.49	.23	1.80	.69	5.12	16.49	10.05	4.04	10.02	6.56	1.37
Sorghum, amber	3	13.62	24.96	17.55	1.03	1.42	1.17	.38	.40	.39	5.34	17.03	9.31	5.45	6.55	5.94	74
Sorghum, ensilaged	5	21.97	28.08	24.17	.56	.94	.75	.14	.42	.28	13.83	19.02	15.82	5.90	6.79	6.28	1.04
Clover, ensilaged	2	21.44	27.40	24.42	3.00	3.81	3.40	.93	1.11	1.02	8.12	11.41	9.76	6.29	8.57	7 43	2.83
Cow-pea vines, green and succulent with pods	3	13.97	27.19	19.69	1.85	3.25	2.70	.21	.62	.47	5 34	8.46	7 41	2.87	15.27	7.22	1.89
Soja bean, whole plant	3	29.59	30.65	30.13	2.20	3.94	3.34	.87	1.55	1.16	14.24	16.01	14.88	7.93	8 91	8.36	2 39
Rye fodder.	6	21.85	25.29	24.72	2.31	3.00	2.61	.20	.72	.56	4.92	12.37	6.94	4.92	14.89	12.73	1.88
Rye fodder, ensilaged	1	.....	.....	19.25	.....	.....	2.42	.....	.....	.27	.....	.....	9 18	.....	.....	5 76	1.62
Carrot leaves	1	.....	.....	16 70	.....	.....	4.26	.....	.....	.86	.....	.....	5.99	.....	.....	2.25	3.34
Beet leaves	1	.....	.....	11.16	.....	.....	2.74	.....	.....	.60	.....	.....	2.49	.....	.....	2.50	2.83
HAY, AND DRY COARSE FODDER.																	
Clover hay	13	78.18	89.80	85.35	8.87	13.54	11.44	1.47	3.10	2.02	35.03	45.47	39.87	23.79	30.83	26.69	5.33
Hay containing much clover	8	85.43	88.63	86.06	6.38	14.42	10.40	1.50	3.09	2.59	35.84	45.19	61.59	19.66	29.53	25.98	5.50
High meadow hay	2	88.65	89.40	89.02	6 79	8.34	7.57	2.03	2.48	2.25	46.93	47.46	47.19	24.34	25 22	25.78	6.23
Timothy hay	32	85.70	93.50	88.81	4.27	9.60	6.02	1.08	3.30	2.20	41.09	58.52	46.26	22.70	37.11	30.35	3.98
Timothy and red top	8	84.78	91.80	86.55	5.14	8.97	6.66	1.45	2.70	2.10	39.20	48.90	28 69	24.72	33.33	28.69	4.09
Mixed meadow grasses	2	.....	.....	85.7	.....	.....	6.76	.....	.....	1.53	.....	.....	46.16	.....	.....	26.85	4.39
Hungarian grass hay	8	.....	.....	8.33	.....	.....	6.59	.....	.....	1 81	.....	.....	42.49	.....	.....	27.16	5.24
Low meadow hay	10	85.50	93.60	89.50	4.60	10.40	7.70	.70	3.60	2.20	39.80	55.20	43.60	21.40	40.00	30.20	5.80
Salt marsh hay	11	81.40	92.80	89.53	4.30	7.80	5.90	1.63	3.10	2.32	34.10	53.67	42.42	27.00	37.90	31.47	7.42
Maize fodder, field cured	6	60.63	77.07	67.95	3.39	4.97	4.29	.66	1.56	1.24	30.52	40.82	35.96	18.65	25.18	22.14	4.32

Buckwheat straw	2	89.50	89.60	89.55	3.33	4.38	3.85	1.42	1.70	1.50	32.08	34.49	33.28	44.93	46.83	45.88	5.05
Oat straw	3	87.50	93.47	89.89	2.30	5.08	3.35	1.00	3.15	2.07	26.42	44.26	36.07	35.21	55.96	42.78	4.72
Rye straw	2	87.50	90.27	88.89	2.19	6.89	4.54	1.00	2.68	1.84	35.70	41.04	38.37	34.20	43.29	38.75	1.84
Wheat straw	1	.....	.....	93.50	.....	.....	4.98	.....	.....	1.49	.....	.....	41.99	.....	.....	38.08	6.96
Cow-pea vines	6	86.01	90.70	88.95	13.56	19.81	15.68	1.13	4.05	2.87	34.98	46.40	42.17	17.20	23.66	19.82	8.41
Grain and Other Seeds.																	
Buckwheat	8	85.10	89.10	87.40	8.60	11.00	10.00	2.20	2.40	2.25	62.60	65.40	64.50	7.80	9.40	8.70	2.00
Barley	9	87.43	92.77	89.08	8.59	15.73	12.39	1.49	3.15	1.88	66.72	73.91	69.88	1.28	4.17	2.57	2.38
Oats	21	86.50	91.10	89.30	8.00	14.40	11.30	4.10	5.80	5.0	57.10	66.90	61.00	1.50	12.98	9.00	3.00
Rye	6	86.90	91.30	88.40	9.50	12.10	10.60	1.40	2.10	1.70	70.70	73.90	72.60	1 40	2.10	1.60	1.90
Wheat, winter	240	83.77	92.90	89.47	8.25	16.63	11.73	1.26	3.93	2.12	68.08	76.64	71.99	.44	2.87	1.77	1.86
Wheat, spring	13	86.65	91.88	89.63	8.14	15.40	12.51	1.82	2.56	2.20	66.07	78.66	71.19	1.33	2.30	1.82	1.91
Wheat, unclassified	54	87.62	90.64	89.28	9.80	14.70	11.97	1.64	2.83	2.09	68.52	74.65	71.49	1.21	3.05	1.91	1.82
Wheat, average of all analyses	307	83.77	92.90	89.45	8.14	16.63	11.86	1.26	3.93	2.10	66.07	78.66	71.87	.44	3.05	1.79	1.83
Maize, dent	78	85.95	93.78	89.90	7.53	12.07	10.34	3.80	6.93	5. 3	66.26	75 73	70.59	1.25	4.81	2.29	1.55
Maize, flint	69	81.84	93.41	88.92	7.00	13.65	10.60	3.40	7.13	4.92	64.95	74.62	70.34	.67	2.88	1.63	1.43
Maize, sweet	25	89.14	94.02	91.27	9.45	15.31	11.63	5.25	11.89	8.32	61.78	72.35	66.58	1.46	5.24	2.82	1.92
Maize, "Western corn"	3	79.30	83.60	80.90	7.80	8.60	8.30	3.60	3.90	3.70	64.90	68.20	66.00	1.70	1.80	1.75	1.20
Maize, averages of all analyses	185	79.30	94.02	89.46	7.00	15 31	10.59	3.40	11.89	5.49	61.78	75.73	69.13	.67	5.24	2.10	1.55
Sorghum seed	9	83.24	90.72	87.48	7.67	11.25	8.88	2.12	4.60	3.65	66.81	73.59	71.27	1.48	3.21	1.88	1.80
Cotton seed, hull and kernel	1	.....	.....	92.28	.....	.....	15.72	.....	.....	18.56	....	.....	29.00	.....	.....	25.75	3.16
Cow pea	5	79.20	89.99	85.21	19.30	23.00	20.77	1.30	1.60	1.43	48.10	61.99	55.75	3.37	5.00	4.06	3.20
Doura, brown	3	87.30	92.40	89.00	9.00	11.50	10.30	.....	.....	4.20	.....	.....	69.90	.....	.....	1.50	1.60
Soja bean	3	89.87	93.95	91.41	34.63	38.62	36.22	16.80	19.00	17.92	26.20	30.50	28.66	3.69	5.00	4.24	4.37
Flour and Meal.																	
Barley meal	3	83.80	86.00	84.90	8 80	13.90	11.80	.70	2.20	1.70	.....	.....	70.90	.....	.....	.10	.50
Buckwheat flour	3	85.06	87.22	86.48	4.18	8.00	6.48	.65	1.74	1.33	75.81	79.37	77.34	.21	.35	.28	1.05
Oat meal	6	91.16	93.77	92.15	12.87	16.25	14.66	6.05	8.77	7.06	66.62	68.99	67.57	.64	1.15	.86	2.00
Rye flour	4	86.42	87.65	86.90	6.00	7.05	6.65	.78	.89	.84	77.56	79.09	78.28	.21	.35	.28	.72
Wheat flour, winter	1	....	.....	87.04	.....	.....	8.56	.....	.....	1.19	.....	.....	76.59	.....	.....	.17	.53
Wheat flour, spring	6	86.50	89.70	87.68	8.56	14.12	10.68	.56	2.01	1.11	68.32	78.11	75.00	.....	1.22	.22	.64
Wheat flour, unclassified	17	86.83	88.81	87.54	9.69	13.31	11.28	.81	1.88	1.15	69.52	76.93	74.43	.06	.99	.16	.52
Wheat flour, average of all analyse	24	86.50	89.70	87.56	8.56	14.12	11.01	.56	2.01	1.14	68.32	78.11	74.67	.....	1.22	.22	.64
Graham flour	3	86.30	87.90	86.90	11.30	12.40	11.70	1.50	1.90	1.70	69.80	70.00	69.80	1.80	1.00	1.90	1.80
Maize meal	34	75.46	90.14	84 97	7.11	13.94	9.09	2.23	4.63	3.73	60.72	73.96	68.86	.50	2.99	1.85	1.45
Hominy	2	86.38	86.64	86.51	8.08	8.41	8.25	.42	.46	.44	77.07	77.18	77.12	.31	.33	.32	.38

COMPOSITION OF FEEDING STUFFS—CONTINUED.

Name.	Analyses.	Total dry matter.			Protein.			Fat.			Nitrogen, free ext			Fiber.			Ash
		Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	
BYE—PRODUCTS AND REFUSE.																	
Brewers' grain, from brewery	15	20.59	31.40	24.99	4.27	7.75	5.57	.79	2.94	1.68	10.11	15.73	12.86	3.05	5.58	3.87	1.01
Brewers' grain, dried	3	88.09	93.77	91.81	19.25	20.25	19.89	4.17	6.51	5.56	46.10	56.80	51.75	10.24	11.60	11.01	3.58
Brewers' grain, kiln-dried	1	.....	.....	97.43	.....	.....	20.30	.....	.....	6.40	.....	.....	54.89	.....	.....	11.79	3.91
Brewers' grain, from silo	3	26.14	33.23	30.18	5.85	7.14	6.64	1.79	2.57	2.11	13.65	16.86	15.58	3.89	5.43	4.64	1.27
Brewers' swill	1	.....	.....	5.70	.....	.....	1.90	.....	.....	.80	.....	.....	2.00	.....	.....	.70	.30
Malt sprouts	3	88.03	92.69	89.73	21.00	25.91	22.95	1.09	2.98	1.79	45.47	50.30	48.60	9.30	11.99	10.72	5.67
Cotton seed meal	24	81.48	94.22	91.67	23.27	50 80	42.06	10.24	18.00	13.24	12.74	38.68	23.43	2.77	11.76	5.69	7.25
Linseed cake	4	89.20	91.65	89.98	31.81	34.93	33.77	4.00	6.06	5.04	33.44	39.11	36.68	7.97	9.36	8.52	5.97
Linseed meal, old process	4	90.00	93.83	91.66	27.68	32.43	30.80	8.20	11.57	10.12	31.29	41.89	34.75	7.26	12.90	10.01	5.98
Linseed meal, new process	12	86.65	93.21	89.88	27.12	37.10	32.94	1.30	6.83	3.57	36.54	48.03	38.35	7.12	13.99	9.09	5.93
Palm nut meal	3	89.16	93.86	91.71	13.53	16.01	14.39	6.41	18.73	13.30	33.85	41.66	38.88	18.75	23.98	21.40	3.74
Rye bran	4	86.30	91.82	88.75	12.60	16.80	15.57	1.79	3.03	2.40	59.75	73.56	65.73	2.50	4.10	3.49	3.57
Wheat bran	30	85.72	91.76	87.92	7.50	16.89	14.82	2.39	5.84	3.67	50.41	58.93	55.04	5.98	16.64	8.55	5.84
Wheat middlings	13	86.15	90.75	88.59	10.13	19.21	13.73	2.07	5.87	3.54	60.21	74.30	66.00	1.27	7.62	4.22	2.65
Wheat shorts	6	86.41	89.04	88.15	11.13	15.13	13.14	2.50	4.85	3.79	55.62	62.32	58.96	6.34	10.47	7.94	4.32
Hominy chops	10	86.54	91.89	88.66	7.88	11.88	9.73	4.45	11.23	8.44	60.95	71.10	65.41	2.54	4.79	3.57	2.47
Gluten meal	6	88.32	92 69	90.70	24.95	35.00	29.62	3.49	8.73	5.69	44.72	58.53	53.10	.68	3.25	1.54	.75
Maize cob	13	85.58	92.82	90.67	1.23	3.73	2.50	.08	.92	.47	45.31	66.38	55.99	28.23	38.26	30.36	1.33
Starch feed, refuse from starch manufacture	5	27.81	37.73	33 51	3.56	6.55	5.24	1.31	3.97	2.53	18.69	28.90	22.68	1.58	4.34	2.84	.22
Sugar feed, refuse from glucose manufacture	2	89.60	93.40	91.50	13.10	13.50	13.30	5.90	11.20	8.60	54.90	61.40	58.10	8.40	10.70	9.50	2.00
Glucose waste, wet	1	.....	.....	24.00	.....	.....	3.72	.....	.....	1.63	.....	.....	17.39	.....	.....	.75	.51
Sorghum meal	1	.....	.....	86.84	.....	.....	8.25	.....	.....	3.85	.....	.....	71.27	.....	.....	1.88	1.59
Sorghum bagasse	3	11.30	16.60	14.50	.62	.68	.65	.....	.....	.....	.....	.....	10.20	2.80	3.30	3.10	.60
Corn and cob meal	1	.....	.....	90 55	.....	.....	9.85	.....	.....	5.19	.....	.....	77.00	.....	.....	6.32	1.64

TABLE II.

Composition of Fruits, Vegetables, Etc.

Name.	Analysis	Total dry matter.			Protein.			Fat.			Nitrogen, free ext.			Fibre.			Ash
		Minimum.	Maximum.	Average...	Minimum.	Maximum.	Average...	Minimum.	Maximum.	Average...	Minimum.	Maximum.	Average...	Minimum.	Maximum.	Average...	
Beets, red	2	10.54	12.32	11.43	1.48	1.73	1.60	.14	.21	.18	7.16	7.64	7.40	.64	1.69	1.16	1.08
Beets, sugar	4	9.24	15.58	11.95	1.69	1.89	1.78	.05	.08	.06	5.67	11.75	8.31	.71	.93	.82	.98
*Beets, sugar				17.70			1.00			.10			15.4			1.30	.80
*Beets, field				11.1			1.10			.10			9.1			.90	.90
Mangolds	3	7.18	8.56	7.96	1.57	1.89	1.71	.03	.51	.20	3.56	4.91	4.18	.76	.91	.82	1.05
Rutabagas	1			12.92			1.15			.09			9.11			1.16	1.41
*Rutabagas				12.00			1.60			.10			9.30			1.10	1.00
Turnips	1			11.11			1.34			.09			8.11			.86	.71
*Turnips				7.74			.95			.10			5.5			1.00	.80
Carrots	3	12.15	13.48	12.00	.84	1.99	1.26	.20	.71	.52	6.86	10.40	8.32	.99	2.32	1.62	1.22
*Carrots				14.00			1.50			.20			10.80			1.70	1.00
Onions	6	6.48	18.43	12.45	.77	2 28	1.41	.22	.36	.26	3.77	14.09	9.53	.59	.76	.69	.56
Potatoes, Irish	5	19.61	23.80	21.45	1.14	2.50	1.95	.02	.14	.09	15.33	19.91	17.99	.28	.85	.56	.86
*Potatoes, Irish				24 10			2.00			.30			21.00			1.10	.90
Potatoes, sweet	3	26.61	34.04	29.72	.45	1.28	.98	.28	.36	.32	23.00	29.72	26.13	.60	2.50	1.36	.93
Yam	1			28.77			2.06			.25			25.24			.70	.67
Cucumbers	2	3.71	4.30	4.01	.79	.83	.81	.21	.22	.22	1.72	1.95	1.84	.53	.85	.69	.45
Squashes	2	4.82	5.42	5.12	.64	68	.66	.24	.32	.38	2.95	3.54	3.24	.53	.54	.54	.40
Tomatoes	1			8.74			1.00			.47			5.84			.70	.73
Peas, green	1			21.94			4.37			.55			14.48			1.66	.88
String beans	1			16.54			2.75			.34			10.04			2.58	.83
Cabbage	1			6.41			2.01			.19			2.00			1.44	.72
*Cabbage				9.80			1.50			.40			6.30			2.00	1.20
Cauliflower	1			9.18			1.62			.79			4.94			1.02	.81
Apples	2	15.89	22.70	19 30	.21	.50	.35	.28	.41	.35	14.26	19.96	17.11	.91	1 37	1.14	.35
†Apples							.50			.41			19.96			1.37	.46

TABLE II—CONTINUED.

Name.	Analyses	Total dry matter.			Protein.			Fat.			Nitrogen, free ext.			Fibre.			Ash
		Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	Minimum.	Maximum.	Average.	
‡Apple, R. I. Greening				17.50			4.57			2.81			83.44			7.10	5.13
‡Apple, sweet				17.50			3.92			1.71			86.21			6.14	2.02
‡Apple pomace, R. I. Greening				17.50			6.94			3.19			70.20			16.58	1.09
‡Apple pomace, Baldwin							7,73			4.37			72.93			13.15	1.82
‡Apple pomace, ensilaged				14.67			8.22			7.36			58.03			22.18	4.21

*German Analyses from Johnson's "How Crops Grow."

†New York Experiment Station.

‡Analysis of dry matter.

TABLE III.

Average Composition of the Ash of Fruits, Vegetables, etc.

Substance.	No of analysis.	Per cent. of ash.	Potash.....	Soda.....	Magnesia.....	Lime.....	Phosphoric acid	Sulphuric acid..	Silica.....	Chlorine.....	Iron oxide.....
Grape seeds.....	2	2.81	28.6	.....	8.6	33.9	24.0	2.5	1.1	0.3	.....
Acorns.....	2	.....	64.5	0.7	5.4	7.0	16.2	2.8	1.1	1.7	.....
Apple—entire fruit.....	4	.....	47.5	5.2	6.9	7.84	9.8	.....	.....	.....	.....
Clinton Grape—entire fruit.	2	.....	58.4	31.5	7.38	13.34	18.19	.....	.....	.....	.89
Pear—entire fruit.....	1	.....	54.7	8.5	5.2	8.0	15.3	5.7	1.5	.....	.....
Cherry—entire fruit.....	1	.....	51.9	2.2	5.5	7.5	16.0	5.1	9.0	1.1	.....
Plum—entire fruit.....	1	.....	59.2	0.5	5.5	10.0	15.1	3.8	2.4	.....	.....
Asparagus—roots of stems..	1	.....	49.68	4.5	10.1	21.3	13.7	.....	.....	.....	.....
Onions.....	1	4.36	38.51	1.9	3.65	8.20	15.80	.....	.....	.....	.58

TABLE IV.

Composition of Ashes.

Substance.	No. of Analyses	Per cent. of ash	Potash	Soda	Magnesia	Lime	Phosphoric acid	Sulphuric acid	Silica	Chlorine
Oak, bodywood	2	.....	10.0	3.6	4.8	73.5	5.5	1.4	1.1	0.2
Oak, small branches with bark	1	.....	19.8	.....	7.5	54.0	9.3	1.6	3.1	.....
Horse chestnut twigs, autumn	1	3.31	19.4	.....	5.2	51.0	21.7	.....	0.7	1.4
Walnut twigs, autumn	1	2.99	15.3	.....	8.1	55.9	12.2	3.2	2.9	0.3
Poplar, young twigs	5	.....	14.0	0.4	7.5	58.4	13.1	1.5	2.0	0.1
Willow, young twigs	1	.....	11.4	5.6	10.1	50.8	16.4	3.1	0.7	0.6
Elm, young twigs	1	.....	24.1	2.1	10.0	37.9	9.6	5.4	6.2	6.7
Elm, bodywood	1	.....	21.9	13.7	7.7	47.8	3.3	1.3	3.1	.....
Linden	1	.....	35.8	6.0	4.2	29.9	4.9	5.3	5.3	1.5
Apple tree	2	1.29	12.0	1.6	5.7	71.0	4.6	2.9	1.8	0.2
Red pine	1	0.25	5.2	26.8	6.2	47.9	5.1	3.0	2.0	4.0
White pine	2	0.28	15.3	9.9	5.9	50.1	5.5	3.0	6.0	0.2
Fir	6	0.31	11.8	4.6	9.1	50.1	5.8	2.3	15.0	0.4
Larch	1	0.32	15.3	7.7	24.5	27.1	3.6	1.7	3.6	0.6
Fruit and Seeds of Trees, etc.										
Grape seeds	2	2.81	28.6	.....	8.6	33.9	24.0	2.5	1.1	0.3
Alder	2	5.14	37.6	1.6	8.0	30.7	13.0	3.4	3.2	0.1
White pine	1	.....	21.8	7.1	16.8	1.5	39.7	.....	11.7	0.3
Red pine	1	.....	22.4	1.3	15.1	1.9	46.0	.....	10.4	.....
Beech nuts	1	3.30	22.8	10.0	11.6	24.5	20.8	2.2	1.9	0.5
Acorns	2	.....	64.5	0.7	5.4	7.0	16.2	2.8	1.1	1.7
Horse chestnuts	2	2.36	58.9	.....	0.5	11.6	22.4	1.4	0.2	6.4
Horse chestnut, green husk	2	4.38	76.4	.....	1.0	10.0	6.3	1.4	0.6	5.6
Apple, entire fruit	1	.....	37.7	26.1	8.8	4.1	13.6	6.1	4.3	.....
Pear, entire fruit	1	.....	54.7	8.5	5.2	8.0	15.3	5.7	1.5	.....

Cherry, entire fruit	1	.....	51.9	2.2	5.5	7.5	16.0	5.1	9.0	1.1
Plum, entire fruit	1	.....	59.2	0.5	5.5	10.0	15.1	3.8	2.4	.....
Bark of Trees.										
Birch	2	1.33	3.8	5.4	8.2	45.6	7.3	1.3	20.1	1.3
Beech	1	.....	14.7	0.4	0.2	57.9	0.4	1.3	18.0	.....
Horse chestnuts, young twigs	1	6.57	24.2	.....	4.0	61.3	7.0	1.1	1.1	1.2
Walnut, young twigs	1	6.40	11.6	.....	10.6	70.1	5.9	0.2	0.7	0.4
Elm	1	.....	2.2	10.1	3.2	72.7	1.6	0.6	8.9	.....
Linden	1	.....	16.1	5.7	8.0	60.8	4.0	0.8	2.3	1.2
Red pine	1	2.81	5.3	4.2	4.7	62.4	2.6	1.0	15.7	0.2
White pine	1	3.30	8.0	3.2	3.0	69.8	2.5	1.6	8.4	1.0
Fir	3	2.01	3.0	1.0	1.4	43.7	8.3	0.8	31.1	0.1
Straw.										
Winter wheat	12	4.96	11.5	2.9	2.6	6.2	5.4	2.9	66.3	....
Winter rye	6	4.81	18.5	3.1	3.1	7.7	4.7	1.9	58.1	.....
Summer rye	3	5.55	23.4	.....	2.8	8.9	6.5	2.6	55.9	.....
Barley	17	5.10	21.6	4.5	2.4	7.6	4.3	3.7	53.8	.....
Oats	6	5.12	22.0	5.3	4.0	8.2	4.2	3.5	48.7	.....
Maize	1	5.49	35.3	1.2	5.5	10.5	8.1	5.2	38.0	.....

TABLE V.

Composition of Ashes—American Analyses.

Kind of Ash.	Moisture	Insoluble in acid	Soluble in acid	Potash	Phosphoric acid.	Lime	Magnesia	Water combined with charcoal.	Salts of lime and magnesia	Sulphuric acid	Undetermined	Carbonic acid
Yellow pine	14.66	17.29				26.06	15.53				25.48	
Ordinary specimen wood ashes		29.25		5.06	1.89	22.92		2.24			38.64	
Wood ashes from house fires				7.51	1.98							
Ash from brick-kilns		64.80		1.42	.80							
Cotton hull ashes				24.64	7.84							
Lime-kiln ashes	25.62	5.76		1.52	2.09	41.54	2.74					19.46
Lime-kiln ashes, unleached	27.49	10.55		1.25	1.98	30.50	2.81					
Canada ashes	21.97	8.64		4.35	1.59	31.33	2.56					
Wood ashes	8.60	16.08		4.25	2.01	35.80	3.91					
Canada ashes, leached	11.60	11.63		2.21	2.02	40.21	3.38					
Canada ashes, unleached	12.78	14.20		5.91	1.93	35.65	2.97					
Ash of spent tanbark	7.75			2.00	2.34	31.56	3.83					
Ash of apple seed	6.53	1.19		53.42	4.27	3.78	3.54			2.96		20.69
Hard wood ash		7.00	93.00	12.25	6.00				70.00			
Soft wood ash		50.00	50.00	12.00	4.00				32.00			
Leached ash		11.00	89.00	1.60	6.80				74.00			
Corn-cob ash		30.00	70.00	45.00	4.50				20.00			
Tannery ash		55.00	45.00	2.50	1.20				41.00			
Soft coal ash		82.00	18.00	.20	.14				5.00			
Hard coal ash		94.50	4.50	.10	.05				2.50			
Dump ash				2.56	1.09	34.25						
Furnace ash	.69			3.84	1.38	42.75						
Tanbark ash	1.05			2.10	1.44							
Soft wood ash, unleached	4.64			4.65	1.78	23.62						
Hard wood ash, unleached	2.14			9.19	3.65	36.48						
Leached ashes, mostly soft wood	31.05			1.53	1.66	26.53						
Grape wood				29.8	12.9	37.3	6.8			2.7		

Mulberry wood	.....	.....	.....	6.5	2.2	57.3	5.7	.....	.....	10.3	.....	.....
Birch wood	.....	.....	.....	11.6	8.5	60.0	8.9	.....	.....	0.3	.....	.....
Beech, body wood	.....	.....	.....	16.1	5.3	56.4	10.8	.....	.....	1.0	.....	.....
Beech, small wood	.....	.....	.....	15.2	11.6	45.8	16.8	.....	.....	0.7	.....	.....
Beech, brush wood	.....	.....	.....	14.1	12.3	48.0	10.8	.....	.....	1.2	.....	.....
Unleached chestnut wood	4.62	26.70	73.30	3.07	2.51	29.15	9.63	.....	.....	2.46	.....	12.80
Unleached oak wood	5.28	22.07	77.93	9.37	2.42	29.65	3.65	.....	.....	1.88	.....	16.57
Unleached hickory wood	4.49	18.09	81.91	4.56	1.63	36.29	5.71	.....	.....	.99	.....	23.22

TABLE VI.

Composition of Soils.

Locality.	Moisture.....	Insoluble sand and silica.....	Soluble silica...	Iron.....	Alumina.....	Phosphoric acid,	Lime.....	Magnesia.....	Potash.....	Soda.....	Sulphuric acid..	Chlorine.....	Carbonic acid...	Volatile and organic matter...	Nitrogen.....
‡Prairie soils from Dakota	6.275	69.335	.499	4.096	7.95	.112	.848	.868	.720	.945	.120	.027	.220	8.905	.324
‡Prairie soils from Dakota	7.800	53.41	.460	4.608	9.930	.112	.852	1.535	.725	.640	.077	.053	.104	6.171	1.79
‡Prairie soils from Dakota	7.700	39.55	.485	3.264	7.382	.224	3.898	2.007	.745	1.500	.163	.078	2.530	10.175	.414
‡Sandy soil from Oregon	.525	78.602	.275	3.920	4.698	.192	1.338	.703	.440	1.690	.043	.020	.005	2.045	.044
‡Washington Territory	1.300	62.165	.260	4.800	6.738	.192	1.433	.659	.495	1.560	.052	.015	.002	3.573	.089
‡Washington Territory subsoil	1.950	62.640	.275	5.248	6.818	.224	1.329	.405	.475	1.070	.060	.020	.116	3.584	.075
‡Washington Territory surface	1.600	63.64	.470	5.050	5.740	.224	2.099	1.411	.545	.830	.069	.030	.110	2.040	.069
‡Washington Territory surface	.675	71.585	.370	4.256	5.328	.216	1.418	.973	.535	.945	.052	.020	.090	1.885	.140
‡Washington Territory surface	1.325	67.575	.575	4.736	5.510	.224	1.428	.947	.940	1.255	.035	.007	.116	1.559	.224
‡Washington Territory surface	1.125	64.860	.385	4.768	6.238	.224	1.449	.991	.700	.700	.129	.014	.000	2.600	.067
‡Michigan	8.300	38.955	.135	.960	3.775	.715	.967	.267	.180	.344	.275	.249	1.389	36.186	1.148
‡Indiana soil	5.300	58.175	.290	2.272	6.397	.041	1.387	.771	.510	.725	.300	.014	1.260	12.165	.575
Indiana subsoil	3.975	62.950	.215	2.720	7.583	.127	1.280	.872	.575	.280	.223	.011	.653	5.622	.252
*Oswego, New York	3.54	73.721	.225	2.837	4.561	.066	.575	.601	.442	.658	.152	.014	.581	5.686	.182
‡Louisiana, alluvial 1 year cultivated	4.235	47.351	.155	4.384	10.096	.160	1.165	2.169	1.470	.780	.086	.014	.549	6.451	.209
‡Louisiana, alluvial 20 year cultivated	2.000	62.968	.164	3.200	7.156	.144	2.060	1.066	.930	.700	.069	.011	1.336	2.639	.120
‡La. red clay, alluvial, 30 years in cultl'n.	2.650	48.679	.065	4.544	10.213	.193	.836	2.547	1.940	.915	.052	.014	1.713	3.463	.140
‡Louisiana. sandy, 50 years in cultivation.	.675	77.92	.035	2.240	4.127	.113	.414	1.131	.805	.730	.052	.018	.940	1.735	.078
†Louisiana	.900	83.060	.030	1.432	3.362	.068	.398	.802	.536	.646	.052	.026	.563	2.124	.086
‡Ohio bottom land soil	2.33	77.915	.....	5.002	5.96	.006	1.54	.117	.43	.44	.53	trace.	.....	5.73	.....
‡Ohio bottom land subsoil	2.18	75.885	.....	5.735	6.000	.01	2.87	1.37	.41	.59	1.23	.....	.....	3.72	.....
‡Ohio upland soil	2.045	77.794	.....	4.07	4.32	.021	1.226	1.523	.45	.47	1.755	.....	.....	7.02	.....
‡Ohio upland subsoil	2.14	76.837	.....	7.61	7.90	.535	3.07	2.773	.50	.504	1.56	.45	.....	3.87	.....
‡Mo., Saline county soil	.5093	84.58	.381	2.55	3.177	.235	.473	.452	.295	.1305	.0287	.0091	.137	6.187	.....
‡Mo., Saline county subsoil	.579	85.29	.279	3.007	3.89	.342	.329	.445	.333	.035	.027	.0071	.072	5.063	.....
‡Mo., Marion county elm land soil	1.092	87.07	.144	2.53	2.40	.1023	543	.437	.1648	.1048	.0757	.0072	1.02	5.45	.....
‡Mo., Marion county elm land subsoil	.....	87.19	.177	3.29	3.69	.094	.294	.565	.298	.130	.0438	.0035	.145	4.33	.....

‡Mo., Marion county resin weed land, prairie soil	.43	86.81	.308	2.32	2.421	.331	.369	.300	6.3134	.122	.0126	.0084	.....	5.56	.....
‡Mo., Marion county resin weed land, prairie subsoil	.763	85.73	.234	3.18	4.15	.215	.456	.528	.393	.064	.0202	.0085	.....	4.17	.....
‡Mo., hickory land from Scotland county soil	1.141	81.40	.083	3.46	4.97	.191	.388	.454	.612	.309	.0302	.0072	.....	7.332	.....
‡Mo., hickory land from Scotland county subsoil	1.051	81.77	.081	4.05	6.25	.142	.221	.473	.469	.249	.018	.0115	.....	5.227	.....
Mo., Scotland county—prairie soil	.752	83.63	.196	2.957	4.68	.068	.307	.307	.326	.140	.021	.0093	.....	7.267	.....
Mo, 6 to 8 inches—below surface	1.002	82.45	.164	4.124	5.783	.030	.206	.402	.392	.166	.034	.0061	.....	5.63	.....
Mo., 18 to 20 inches—below surface	1.325	82.75	.101	2.893	3.959	.....	.213	.460	.344	.168	.032	.0082	.....	7.28	.....
Mo. Chariton Co —bot. land, 2-6 in. of surf	.707	87.37	.201	2.044	3.207	.387	.548	.492	.314	.204	.072	.0068	.....	4.418	.....
Mo., 10 to 12 inches of surface	.965	87.97	.179	1.971	3.502	.271	.475	.200	.476	.158	.076	.0082	.....	3.649	.....
Mo., 18 to 20 inches of surface	.925	89.37	.215	2.046	3.446	.202	.423	.210	.418	.083	.077	.0057	.....	2.262	.....
Mo, 30 to 36 inches of surface	.508	90.85	.114	2.060	3.039	.214	.457	.278	.266	.173	.061	.0102	.....	2.178	.....
Mo, Mississippi county	.455	84.77	.133	2.38	3.286	trace.	1.389	.971	.437	.168	.300	.....	.....	6.270	.....
Mo., Boone Co.—12 feet from surface	5.736	77.70	.....	3.07	10.23	.214	.370	.272	.575	1.525	.....	.....	.6426	.....	.....
Mo, white oak ridge, 2 to 6 inches deep	.410	90.14	.138	2.055	3.065	.056	.2086	.342	.337	.1828	.0035	.....	.....	3.095	.....
Mo, white oak ridge, 10 to 12 ft. below surf	.803	85.06	.218	3.88	4.767	.055	.472	.658	.389	.122	.0099	.0276	.....	3.89	.....
Mo., white oak ridge, 18 to 20 ft. " "	.655	90.80	.147	2.059	2.934	.034	.124	.205	.212	.292	.0508	.....	.....	2.605	.....
Mo., Callaway county—limestone soil	1.170	54.26	.164	2.518	10.86	.095	8.07	1.66	1.637	.334	.0605	.0053	10.11	9.629	.....
Granite soils—average of 5 specimens	1.87	73.9	.....	6.21	10.03	.14	.17	.059	.14	.....	.006	.....	.....	6.75	.11
Limestone—11 specimens	1.71	78.2	.....	4.48	7.10	.17	.38	.065	.31	.....	.022	.....	.....	5.9	.13
State—5 specimens	1.21	77.3	.....	4.94	9.15	.20	.22	1.49	.48	.....	.008	.....	.....	6.0	.13
Red sandstone—8 specimens	2.42	80.0	.....	4.11	6.08	.80	.51	.74	.24	.....	.022	.....	.....	5.9	.22
Trap—6 specimens	5.88	65.7	.....	10.06	12.08	.09	.24	.77	.14	.....	.012	.....	.....	7.0	.05
Clay and sand—2 specimens	0.73	90.8	.....	2.45	2.13	.09	.10	.018	.22	.....	.....	.....	.....	3.2	.10
Oak land—13 specimens	0.72	92.1	.....	1.68	2.69	.03	.01	.016	.05	.....	.008	.....	.....	2.04	.04
Pine land—6 specimens	0.20	98.4	.....	0.35	0.37	.02	.009	.001	.01	.....	.004	.....	.....	0.5	.01
Alluvial soil—2 specimens	1.20	80.7	.....	1.47	1.47	.10	.42	.001	.01	.....	.05	.....	.....	5.0	.16
Illinois soil	5.68	89.4	.....	.....	.....	.23	.50	.04	.42	.....	.13	.....	.....	.....	.....
English soil	.....	83.0	.....	5.20	3.40	.14	1.36	.40	.36	.....	.06	.....	.....	5.63	.17
English sub-soil	.....	93.9	.....	3.20	0.44	.05	0.15	.20	.25	.....	.08	.....	.....	1.53	.14
California soil	4.51	73.9	.....	3.34	4.03	.14	.97	.73	.56	.....	.04	.....	.....	4.11	.....
California sub-soil	.....	48.9	.....	7.91	14.98	.04	2.77	1.80	.22	.....	.06	.....	.....	.....	.....
Connecticut soil	4.20	80.5	.....	0.18	.....	.04	.52	.....	.02	.....	.015	.....	.....	.....	.....
Fertile soil of Holland	.....	57.64	2.34	9.389	1.83	.466	4.09	0.130	1.026	1.97	.896	1.24	6.085	.....	.08
Wheat soil, of Mid. Lothian	2.68	71.55	.....	5.173	6.93	.430	1.229	1.082	.354	.433	.044	.....	.....	10.19	.....
Sterile soil from Bavaria	.53	95.86	.016	7.20	9.70	trace	.096	trace.	none.	none.	.....	trace.	trace.	1.85	.....

TABLE VI—CONTINUED.

Locality.	Moisture.....	Insoluble.....	Soluble silica...	Iron	Alumina.....	Phosphoric acid.	Lime.....	Magnesia.....	Potash.....	Soda.....	Sulphuric acid..	Chlorine.....	Carbonic acid...	Volatile and organic matter...	Nitrogen.....
Conn. soil	2.35	83.10	.....	2.37	1.255	.038	.130	.130	.056	.074	.059	.....	.....	10.47	.334
Conn. sub-soil	.473	87.91	.....	3.34	1.222	.051	.080	.186	.047	.093	.041	.....	.....	6.577	.140
Average soil	2.324	73.15	.290	3.739	5.057	.179	.989	.667	.486	.582	.128	.066	1.39	5.774	.2547
Average sub-soil	1.629	78.05	.201	4.227	8.156	.145	1.08	.722	.392	.442	.282	.053	.325	4.002	.....

‡ Authority—U. S. Department, by E. Richards, in Bulletin No. 10.
* Average of 4 analyses.
† Average of 2 analyses.

TABLE VII.

Average Composition of Various Manures.

Name of Fertilizer.	Water.....	Organic substance.....	Ash.....	Nitrogen.....	Potash.....	Soda.....	Lime.....	Magnesia.....	Phosphoric acid.	Sulphuric acid.	Silica and sand.
ANIMAL EXCREMENT.											
Fresh or green—horse solid	75.7	21.1	3.16	.44	.35	.06	.15	.12	.35	.06	.196
horse, urine	90.1	7.1	2.8	1.50	1.50	.25	.45	.24	.....	.06	.08
horse fresh dung with straw	71.3	25.4	3.2	.58	.53	.10	.21	.14	.28	.07	1.77
Cattle—fresh fæces	8.38	14.5	1.7	.29	.10	.02	.34	.13	.17	.04	.72
fresh urine	93.8	3.5	2.7	.58	.49	.64	.01	.04	.....	.13	.03
fresh dung with straw	77.5	20.3	2.1	.34	.4	.14	.31	.11	.16	.06	.85
ordinary manure	83.	14.0	2.88	.60	.65	.17	.70	.17	.20	.10	.70
Sheep—fresh fæces	65.5	31.4	3.11	.55	.15	.10	.46	.15	.31	.14	.....
fresh urine	87.2	8.3	4.52	1.95	2.26	.54	.16	.34	.01	.30	.....
fresh dung with straw	64.6	31.8	3.56	.83	.67	.22	.33	.18	.23	.15	.....
solid excrement	.....	.....	.....	.21	.237	.....	.....	.....	.29	.....	.....
urine (dried residue)	.....	.....	.....	.66	.20	.....	.....	.....	.....	.....	.....
Swine—fresh fæces	.82	15.	3.	.60	.26	.25	.09	.10	.41	.04	1.5
fresh urine	96.7	2.8	1.5	.43	.83	.21	.....	.08	.07	.08	.....
fresh dung with straw	72.4	25.	2.5	.45	.60	.20	.08	.09	.19	.08	1.0
Hen manure—fresh	56.	25.5	18.5	1.63	.85	.10	.24	.74	1.54	.45	3.52
dry	.....	.....	.....	2.81	1.59	.....	.....	.....	2.43	.....	.....
fresh	58.82	16.24	24.94	.80	.35	.....	.....	.....	.62	.....	20.23
sweepings	43.81	18.18	38.01	.88	.....	.....	.....	.....	.....	.....	31.50
Dove manure—fresh	51.9	30.8	17.3	1.76	1.00	7.	1.6	.50	1.78	.33	2.02
Duck manure—fresh	56.6	26.2	17.2	1.00	.62	.05	1.7	.35	1.4	.35	2.8
Geese manure—fresh	77.1	13.4	9.5	.55	9.5	.13	.84	2.00	.54	.14	1.4
Elephant's dung	78.79	19.63	1.58	.22	.30	.08	.10	.06	.13	.05	.81
Barnyard manure—fresh	71.0	24.6	4.41	.45	.52	.15	.57	.14	.21	.12	1.25
Barnyard manure—moderately rotted	75.	19.2	5.8	.50	.63	.19	.70	.18	.26	.16	1.68

TABLE VII.—CONTINUED.

Name of Fertilizer.	Water.....	Organic substance.....	Ash.....	Nitrogen.....	Potash.....	Soda.....	Lime.....	Magnesia.....	Phosphoric acid.	Sulphuric acid..	Silica and sand..
Barnyard manure old	54.70	10.87	34.43	.46	.16	.07	.47	.50	.72	.01	30.5
" " thoroughly rotted	79.	14.5	6.50	.58	.50	.13	.88	.18	.30	.13	1.70
Drainage from barnyard manure	98.2	.7	1.07	.15	.49	.10	.03	.04	.01	.07	.02
Human- fæces fresh	76.1	20.97	2.93	1.25	.27	.12	.52	.37	1.08	.07	.28
urine fresh	96.6	2.21	1.16	.59	.13	.46	.019	.017	.16	.047	.003
Mixed human excrement, fresh	93.	5.1	1.6	.70	.21	.38	.09	.06	.26	.05	.02
Human excrement, liquid	95.5	3.00	1.5	.35	.20	.40	.10	.06	.28	.04	.02
Human fæces, absolutely dry	.....	88.52	11.48	6.00	1.19	.31	1.72	1.55	4.27	.24	1.48
Solid dry matter of human urine	.....	67.54	32.46	19.43	1.83	.....	.61	.47	4.66	.46	.09
Ox-blood	79.	.....	.75	3.2	.06	.34	.01	.01	.04	.02	.01
Eggs	67.	.....	6.18	2.18	.15	.14	5.4	.10	.37	.01	.01

TABLE VIII.

Composition of Marls, Lime, etc.

Locality and kind of Marl.	Insoluble matter.	Moisture.....	Organic matter.	Carbonic acid...	Lime.....	Magnesia.....	Potash.....	Soda.....	Phosphoric acid.	Sulphuric acid..	Iron and alumnia.	Equiv. to carbonate of lime.	Equiv. to magnesium carbonate.....	Phosphate of lime.....	Nitrogen.....
Alabama. Average of 20 analyses.....	59.09	.....	.....	.....	15.75	3,61	.30	.....	.15	.39	4.78	27.23	.....	.....	.....
Florida marl.....	21.95	.60	.....	.....	41.75	1.03	.....	.....	2.72	.....	.36	.....	.....	.....	.....
Mich. Berrien county.....	13.00	.....	1.43	.....	.....	.....	.....	.....	.....	.....	2.43	79.60	4.54	.....	.....
St. Joseph county.....	36.79	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.05	56.16	6.00	.....	.....
Lenawee county.....	5.50	.....	2.50	.....	.....	.....	.....	.....	.....	.....	.....	90.00	2.00	.....	.....
Otsego county.....	16.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	80.00	2.50	1.50	.....
Conn. Shell marl.....	16.88	23.72	5.87	21.77	27.99	.97	Trace	.59	Trace	.46	1.55	.....	.....	.....	.44
N. J. Green marl.....	18.33	16.70	.....	.....	.43	3.12	5.69	.60	.90	.42	23.00	.....	.....	.....	.....
Green marl.....	50.80	9.66	.....	.....	2.13	3.54	5.18	.....	2.24	.39	26.40	.....	.....	.....	.....
Ala. Phosphatic marl.....	31.55	.....	6.00	15.70	29.76	.22	2.01	.....	3.56	.....	11.85	.....	.....	.....	.....
Phosphatic nodules.....	29.95	.....	.....	3.82	33.60	1.01	.39	.....	26.59	.....	5.62	.....	.....	.....	.....
Picked green sand grains.....	57.56	8.17	.....	.....	1.04	1.70	4.88	.....	.....	.....	26.69	.....	.....	.....	.....
Picked green sand grains.....	58.82	8.98	.....	.....	.81	1.17	3.92	.....	.....	.....	25.24	.....	.....	.....	.....
Miss. Clark county.....	45.88	.....	.....	12.49	14.78	2.47	1.71	.46	.33	.56	20.77	.....	.....	.....	.....
Hinds county.....	37.4	.....	.....	23.08	28.81	1.41	.44	.21	.26	.....	5.13	.....	.....	.....	.....
Warren county.....	20.97	.....	.....	30.83	37.54	2.08	.75	.28	.13	.....	4.72	.....	.....	.....	.....
Rankin county	13.07	.....	.....	34.75	46.22	.61	.26	.03	Trace	.058	2.72	.....	.....	.....	.....
Carroll county.....	55.76	.....	.....	.13	.16	1.63	1.60	.04	Trace	.....	34.35	.....	.....	.....	.....
Marion county.....	80.56	.....	.....	3.37	2.80	1.15	.77	.18	.13	.02	11.08	.....	.....	.....	.....
Franklin county.....	49.47	.....	.....	9.55	13.19	1.82	1.24	.15	.13	.03	18.12	.....	.....	.....	.....
Lowndes county.....	88.70	.....	.....	.47	1.35	.72	.20	.19	.33	.01	5.59	.....	.....	.....	.....
Tippah county.....	67.92	.....	.....	7.77	7.13	1.22	.71	.27	.15	.....	15.32	.....	.....	.....	.....
Chicasaw county.....	35.75	.....	.....	16.76	20.55	1.36	.68	.19	.....	1.74	13.66	.....	.....	.....	.....
Adams county. Lake marl.....	17.44	.....	.....	.....	.....	.64	3.64	.36	.....	.....	7.10	70.44	.....	.....	.....
Kentucky. Union county.....	32.67	.....	7.06	.....	.....	.69	.31	.16	.28	1.36	6.70	50.85	.....	.....	.....
Bullitt county.....	48.84	.....	1.90	.....	.....	1.08	.57	.15	.15	.06	5.48	41.74	.....	.....	.....
Fayette county.....	56.88	.....	5.67	.....	.....	3.27	6.65	.19	.18	.....	24.65	2.48	.....	.....	.....

TABLE VIII—CONTINUED.

Locality and kind of Marl.	Insoluble matter.	Moisture.....	Organic matter.	Carbonic acid...	Lime.....	Magnesia.....	Potash.....	Soda.....	Phosphoric acid.	Sulphuric acid..	Iron and alumnia.....	Equiv. to carbonate of lime.	Equiv. to magnesium carbonate.....	Phosphate of lime.....	Nitrogen.....
Kentucky. Fleming county	39.78	.....	13.96	.....	.....	6.38	1.14	.....	.07	.33	22.24	16.88	.....	.....	.....
Grant county	71.28	.....	1.53	.....	.....	3.28	.98	.17	.31	1.19	16.25	4.98	.....	.....	.....
Jefferson county	59.90	.....	2.19	.....	.....	1.68	.96	.01	.69	.40	7.26	26.88	.....	.....	.....
Mason county	78.18	.....	.79	.....	.....	3.10	.72	.17	1.04	.59	8.02	7.38	.....	.....	.....
Owen county	29.24	.....	8.99	.....	.....	5.28	.65	.....	.932	.37	19.94	34.58	.....	.....	.....
Gypsum	.....	.21	.....	.....	45.5	.....	.....	.....	.....	32.5	.....	.....	.....	.....	.....
Lime	.28	20.25	.....	7.76	70.12	.67	.....	.....	.....	.....	.20	.....	.....	.....	.....
Oyster shell lime	7.32	16.93	.....	7.17	64.47	.41	.04	.16	.17	.52	1.50	.....	.....	.....	.....
Oyster shell screenings	6.12	13.17	.....	22.34	53.82	.24	.03	.15	.15	.23	1.14	.....	.....	.....	.....

DAIRY PRODUCTS.

The following table contains the mean of all available American analyses of milk, butter and cheese conducted by our agricultural experiment stations that were in form for tabulation. In every instance the article analysed was produced on the station grounds, thereby assuring us that the article was pure and not a mixture of the ordinary commercial adulterations:

TABLE IX.

	Milk.	Butter.	Cheese.
Number of analyses	5	4	7
Specific gravity	1.0322	.....	.....
Solids	14.02	84.19	67.49
Fat	4.71	80.18	34.78
Casein	3.82	.66	29.08
Sugar	4.83	.....	.....
Ash	.675	3.31	3.72

The following table is the average of all prize winning animals shown at the Kansas City and American Fat Stock Shows, save one Kansas City show, the data of which was not available to me at the time of making the table. It will be found of much value for study. While these shows have thus far failed in gaining those ultimate facts that stockmen most need, yet as the result of fairs multiply, very valuable facts for breed comparisons will be ascertained. Indeed, they are already strongly suggestive to an attentive student of our domestic animals:

I. CATTLE.

Comparative Weights, etc.,

Name of Breed.	Average gain per day since birth	Live weight at slaughter..... ..	Tallow.....	Hide	Left fore quarter ...	Right fore quarter..
Under one year.						
Aberdeen-Angus	4.55	912	.....	.....	.....	.....
Short-horn	2.26	535	.....	.....	.....	.....
Grade Hereford.....	2.80	925	36	76	140	139
Between one and two years.						
Aberdeen-Angus	2.36	1,372	.....	.....	.....	.....
Devon	1.41	805	.....	.....	.....	.....
Hereford.....	1.98	1,225	84	106	230	228
Galloway.....	1.99	1,345	77	92	225	223
Short-horn.....	2.06	1,226	49	74	213	205
Grade Hereford	2.10	1,233	70	84	194	192
Grade Short-horn.....	2.14	1,291	71	75	189	188
Grade Angus.....	2.29	1,355	71	72	220	219
Between two and three years.						
Aberdeen-Angus	1.41	1,935	136	85	326	317
Devon.....	1.16	1,171	49	68	175	173
Hereford	1.65	1,596	80	95	279	278
Short-horn.....	1.77	1,692	110	93	281	284
Grade Hereford.....	1.81	1,706	116	98	285	283
Grade Short-horn	1.82	1,707	75	89	275	273
Angus Short-horn.....	1.78	1,655	84	90	301	302
Three years and over.						
Aberdeen-Angus	1.51	2,050	140	95	362	354
Devon.....	.95	1,263	.....	.....	.....	.....
Holstein.....	1.28	1,765	.....	.....	.....	.....
Hereford	1.44	2,009	128	88	369	370
Short-horn.....	1.45	2,015	126	89	368	368
Grade Hereford	1.51	1,955	129	123	337	340
Grade Short-horn	1.58	2,040	111	97	363	360

I. CATTLE.

of the different Breeds.

Left hind quarter...	Right hind quarter.	Head	Feet	Paunch	Guts	Liver	Heart.....	Tongue..	Lungs	Blood.....	Loss in weight by shrinkage	Number of animals weighed .....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
142	139	21	15	97	41	11	3	7	12	7	30	1
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4
218	212	32	18	101	18	13	3	9	14	35	17	1
208	203	29	20	118	34	13	6	9	8	39	.....	1
208	210	26	18	115	34	12	5	8	16	20	.....	2
190	186	30	15	102	29	12	4	7	13	31	34	7
181	177	27	17	102	38	13	5	7	13	21	32	5
220	218	25	16	132	44	11	5	8	14	27	.....	1
298	294	35	21	115	46	15	6	12	20	13	46	1
164	161	30	14	105	36	11	5	8	13	27	.....	2
264	261	36	18	126	40	14	5	9	16	24	35	9
270	271	32	21	131	.....	17	6	9	19	12	41	1
259	258	37	19	129	49	13	5	8	14	39	35	8
254	253	32	19	138	52	14	5	9	17	25	.....	7
273	267	30	21	124	36	12	5	10	16	35	.....	1
320	325	35	22	128	49	15	6	12	21	36	.....	2
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
348	337	37	19	135	64	17	8	10	20	34	39	7
347	335	37	19	125	59	17	8	9	19	39	.....	7
298	295	40	19	143	47	14	5	10	15	43	.....	10
320	316	38	21	155	46	17	6	10	19	43	.....	12

COMPARATIVE MEASUREMENTS OF DIFFERENT BREEDS OF CATTLE.

Name of Breed.	No. of animals.	Girth at throat latch	Girth at middle of paunch.	Depth from loin to hock	Length of quarter from loins to rump.	Width across loins	Length of back from top of shoulder to loins	Thickness through crops	Depth from top line to lower shoulder point	Flank girth	Heart girth	Length of carcass	Height from ground. Flank	Fore flank	Hip	Shoulder
		ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
Under one year.																
Aberdeen-Angus	1	2 9	2 7	2 8	1 8	1 5	2 6	1 6	2 4	6 2	5 8	5 6	2 0	1 11	4 2	3 11
Devon	7	2 7	2 6	2 10	1 7	1 5	2 6	1 6	2 0	6 10	5 10	5 6	2 1	1 10	4 2	3 7
Hereford	2	2 11	2 9	2 10	1 5	1 9	2 1	1 8	2 3	6 8	5 9	5 6	2 1	1 9	4 0	3 10
Short-horn	4	2 8	2 6	2 5	1 6	1 8	2 2	1 8	2 3	6 9	5 6	5 6	2 2	1 10	4 1	4 0
Grade, Angus	1	2 10	2 8	2 5	1 7	1 8	2 4	1 9	2 1	6 0	5 10	5 9	2 2	1 11	4 2	3 11
" Hereford	2	2 10	2 9	2 5	1 6	1 7	2 4	1 8	2 3	5 11	5 10	5 10	2 2	1 30	4 2	4 0
" Short-horn	1	2 9	2 6	2 3	1 6	1 8	2 3	1 8	2 3	5 9	5 6	5 5	2 1	1 11	4 1	3 11
Between one and two years																
Aberdeen-Angus		3 2	2 11	3 0	1 9	1 11	2 4	1 11	2 7	6 10	6 10	6 4	2 2	1 9	4 5	4 4
Devon	5	2 11	2 9	3 0	1 5	1 7	2 6	1 7	2 3	5 9	5 10	5 9	2 4	1 10	4 2	4 1
Holstein	7	3 1	3 0	3 3	1 6	1 11	2 8	1 11	2 9	6 8	6 6	6 0	2 4	2 0	4 7	4 6
Hereford	1	3 1	3 0	3 4	1 6	1 11	2 5	1 10	2 6	6 8	6 6	6 0	2 4	2 0	4 3	4 3
Short-horn	14	3 3	3 0	3 4	1 6	2 0	2 8	2 0	2 7	6 8	6 7	6 3	2 4	2 0	4 6	4 6
Grade, Angus	24	3 3	3 2	3 5	1 7	1 10	2 8	1 11	2 8	6 7	6 6	6 2	2 2	1 11	4 4	4 3
" Hereford	148	3 1	3 0	3 5	1 8	1 10	2 6	1 10	2 5	6 7	6 6	6 2	2 2	1 11	4 3	4 3
" Short-horn	140	3 1	3 2	3 3	1 9	1 11	2 6	1 10	2 7	6 9	6 8	6 2	2 4	1 11	4 5	4 4
Between two and three years.																
Aberdeen-Angus	6	3 4	2 7	4 1	1 8	2 1	2 6	2 1	2 10	7 6	7 7	6 7	2 2	1 11	4 8	4 8
Devon	7	3 1	2 7	3 11	1 7	1 9	2 6	1 9	2 4	6 3	6 5	5 8	2 4	1 10	4 3	4 2
Hereford	16	3 4	3 4	3 11	2 0	2 1	2 10	2 0	2 8	7 7	7 5	6 4	2 2	1 10	4 6	4 6
Short-horn	24	3 3	3 5	3 6	1 10	2 2	2 9	2 1	2 8	7 7	7 6	6 5	2 3	1 11	4 7	4 9
Grade, Hereford	21	3 5	3 6	3 7	1 11	2 2	2 9	2 1	2 8	7 7	7 6	6 1	2 5	1 11	4 9	4 7
" Short-horn	42	3 4	3 5	3 8	2 0	2 2	2 6	2 0	2 8	7 9	7 6	6 1	2 5	1 11	4 9	4 7

| Over three years. | | |

IV. SHEEP.

Comparative Measure-

Name of breed.	Length of carcass	Heart girth	Flank girth	Height from ground. Shoulder	Hip	Fore flank	Flank	Live weight
Under one year.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in	
Cotswold	3 3	3 6	3 7	2 6	2 3	1 4	1 4	151
Southdown	2 8	3 0	3 2	2 0	1 11	0 11	1 0	125
Shropshiredown	2 10	3 6	3 7	2 6	2 7	1 3	1 5	125
Leicester	3 0	3 1	2 8	2 3	2 3	1 7	1 4	134
Merino								64
Grades	3 1	1 10	3 10	2 5	2 4	1 0	1 1	120
Between one and two years.								
Cotswold	3 3	4 4	4 3	2 7	2 6	1 2	1 3	214
Southdown	3 0	3 8	3 11	2 3	2 1	1 0	1 1	162
Shropshiredown	3 5	4 1	4 1	2 7	2 9	1 2	1 5	185
Leicester								235
Merino	3 2	3 6	3 6	2 5	2 7	1 3	1 5	94
Grades	3 3	3 11	4 0	2 5	2 4	1 0	1 1	187
Between two and three years.								
Cotswold	3 7	4 7	4 5	2 10	2 9	1 2	1 4	256
Southdown	3 7	4 3	4 2	2 10	2 11	1 3	1 6	206
Shropshiredown	3 6	4 5	4 5	2 7	2 4	1 2	1 3	218
Leicester	3 2	4 9	4 3	2 4	2 7	1 2	1 5	274
Merino	3 0	3 6	3 6	2 4	2 5	1 2	1 4	133
Grades	3 2	4 1	4 2	2 5	2 5	1 1	1 2	224
Over three years.								
Cotswold	3 2	4 9	4 8	2 5	2 6	1 1	1 3	295
Southdown	3 2	3 10	4 1	2 2	2 2	1 0	1 0	.....
Shropshiredown	3 3	3 10	4 1	2 4	2 4	1 1	1 1	.....
Leicester								
Merino								122
Grades	3 3	3 11	4 1	2 3	2 3	1 0	1 0	197

IV. SHEEP.

ments and Weights.

Average gain per day...	Weight of dressed carcass	Weight of pelt.....	Weight of tallow.....	Weight of head.....	Weight of lungs & heart.	Weight of liver and melt.	Weight, paunch and intestines.....	Weight of blood.....	Shrinkage	Number measured.....	Number weighed.	Number slaughtered....
.70	.....	.....	.....	.....	.....	.....	.....	.....	.....	6	10	.....
.55	.....	.....	.....	.....	.....	.....	.....	.....	.....	5	9	.....
.46	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	4	.....
.58	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	3	.....
.29	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....
.56	56	12	2	3½	2½	2	15	5	28	11	26	1
.34	113	23	6	5½	3	2	29	9	.....	23	31	1
.27	104	14	7	4	2	1	22	3	5	12	29	3
.31	.....	.....	.....	.....	.....	.....	.....	.....	.....	6	11	.....
.40	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4	.....
.16	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	2	.....
.34	100	16	7	4½	2	2	21	5½	5	22	31	6
.26	168	20	17	.....	.....	.....	.....	.....	.....	15	21	1
.21	105	10½	14	.....	.....	.....	.....	.....	.....	6	19	1
.22	135	22	6	5	3	2	29	7	7	4	14	3
.28	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	7	.....
.15	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	6	.....
.21	168	20	17	.....	.....	.....	.....	.....	.....	21	38	1
.23	.....	.....	.....	.....	.....	.....	.....	.....	.....	11	11	.....
.13	.....	.....	.....	.....	.....	.....	.....	.....	.....	6	6	.....
.14	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	2	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.06	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	12	.....
.14	.....	.....	.....	.....	.....	.....	.....	.....	.....	8	6	.....

HOGS.

Comparative Weights.

Name of Breed.	Live weight at slaughter	Aver. gain per day since birth	Weight dressed carcass and head	Weight of lungs and heart	Weight of liver and melt	Weight of paunch	Weight of guts	Weight of blood	Weight of hair, wet.	Shrinkage	No. weighed	No. slaughtered
Under one year.												
Poland	292	1.17	189	25	3	3	12	3	2	12½	19	2
Berkshire	350	1.13									8	
Essex	233	1.02	267	3	4	4	15	4	3	4	17	3
Victoria	333	1.07	292	3½	4	2½	15	4½	3		12	1
Chester White	291	1.17									10	
Jersey Red	359	1.16	310	4	4½	3	17	5	6	5	3	2
Grades	326	1.10	202	4	4	4	17	5	4		21	2
Between one and two years.												
Poland	465	.90	435	5	5	6½	20½	7	5	15	49	3
Berkshire	446	.80	310	3	4½	2½	15	6	4	4½	15	1
Essex	386	.77									14	
Victoria	429	.97	425	4	4	6	19	6	5	31	12	2
Chester White	476	.95									11	
Jersey Red	484	1.39	390	5	5	8	25	7	5	17	6	3
Grades	451	.92		6½	6	9	36	9½	5½	24½	31	1

HOGS.

Comparative Measurements of the Several Breeds.

Name of Breed.	Length of carcass		Heart girth		Flank girth		Height from Ground. Top line. Shoulder		Height from Ground. Top line. Hip		Height from Ground. Bot. line. Fore Flank		Height from Ground. Bot. line. Flank		Depth from top line to lower shoulder point		Thickness through the crop		Length of back from top of shoulder to loin		Width across the loins		Length of quarter from loin to rump		Depth from loin to hook		Girth of paunch (middle)		Girth of throatlatch		Number measured
Under one year.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in	ft.	in.	ft.	in	
Poland	3	8	4	4	4	4	2	3	2	5	0	7	0	8	1	8	1	3	1	8	1	1	1	1	2	0	4	7	3	3	13
Berkshire	4	0	4	7	4	5	2	6	2	6	0	6	0	7	1	9	1	4	1	8	1	2	1	1	1	11	4	9	3	3	7
Essex	3	7	2	11	4	0	2	2	2	4	0	7	0	7	1	7	1	2	1	6	1	1	1	1	1	11	4	4	2	11	9
Victoria	4	3	4	9	4	8	2	7	2	7	0	6	0	6	1	11	1	5	1	7	1	2	1	1	2	1	4	9	3	4	6
Chester white	4	0	4	5	4	4	2	5	2	7	0	8	0	9	1	9	1	4	1	9	1	2	1	2	2	1	4	8	3	5	9
Jersey red	4	1	4	10	4	9	2	6	2	8	0	7	0	8	2	3	1	2	2	1	1	2	1	1	2	3	5	0	3	6	1
Grades	4	1	4	8	4	7	2	6	2	7	0	7	0	7	1	10	1	4	1	10	1	2	1	2	1	1	4	9	3	7	12
Between one and two years.																															
Poland	4	6	5	4	5	4	2	10	2	11	0	8	0	7	2	1	1	7	2	0	1	5	1	3	2	5	5	7	3	8	24
Berkshire	4	5	5	2	5	1	2	9	2	9	0	7	0	7	2	2	1	5	1	11	1	4	1	3	2	4	5	4	3	9	13
Essex	4	2	5	0	4	11	2	8	2	8	0	7	0	8	2	0	1	5	1	9	1	3	1	1	2	3	5	2	3	7	12
Victoria	4	8	5	4	5	2	2	9	2	10	0	8	0	8	2	2	1	6	1	10	1	4	1	3	2	4	5	5	3	6	3
Chester white	4	5	5	1	5	1	2	9	2	10	0	8	0	8	2	1	1	6	1	11	1	4	1	2	2	4	5	5	3	6	9
Jersey red	4	8	5	3	5	2	2	10	3	0	0	10	1	0	2	3	1	4	2	4	1	4	1	1	2	4	5	7	3	10	9
Grades	4	4	5	2	5	1	2	8	2	9	0	7	0	8	2	1	1	6	2	0	1	4	1	2	2	2	5	3	3	11	14

*Made by T. C. Thomas, C. E.

CATTLE.

Name of Breed.	No. of cattle measured.	No. of cattle weighed.	No. of cattle slaughtered	Name of Breed.	No. of cattle measured.	No. of cattle weighed.	No. of cattle slaughtered
Under one year.				**Between 2 and 3 years.**			
Aberdeen—Augus....	1	2	.....	Aberdeen Augus.....	6	6	2
Devon.....	3	3	.....	Devon	7	4	2
Hereford.....	2	2	.....	Holstein.	1	1	.....
Short-horn.....	4	4	.....	Short-horn.....	24	47	1
Grade short-horn....	1	.....	.....	Hereford.....	16	26	9
" Hereford.....	2	2	1	Grade Hereford.....	21	18	8
				Grade Short-horn.....			
Between 1 and 2 years				Angus Short-horn.....			
Aberdeen Augus.....	5	4	.....	**Over three years.**	40	37	7
Devon	7	4	.....	.....	.....	1	1
Galloway.....	.....	1	1	Aberdeen—Angus.....	2	7	2
Holstein.	1	.....	.....	Devon	7	7	.....
Hereford.....	14	19	1	Holstein.	2	2	.....
Short-horn.....	24	37	2	Hereford.....	20	25	7
Grade Augus.....	.....	1	1	Short-horn.....	28	52	7
" Hereford.....	48	43	7	Grade Hereford.....	25	26	10
" Short-horn....	40	36	5	" Short-horn.....	43	31	12

BULLETIN NO. 19.

FEEDING FOR LEAN MEAT.

MISSOURI AGRICULTURAL COLLEGE,
COLUMBIA, MO., Jan. 29, 1886.

S. S. LAWS, LL. D., *President University of Missouri:*

SIR: In Bulletins Nos. 10 and 14, I gave the results of feeding experiments to ascertain the influence of food on the relation of lean to fat, in pork production. Both investigations resulted in a larger proportion of lean meat in the pigs receiving albuminous foods versus carbonaceous foods.

Desiring to make the matter conclusive, I have gone more fully over the same ground for the third season and trial.

This investigation, hereinafter given, is in complete accord with the previous results and may be regarded as conclusive evidence that food makes a profound change in the composition of an animal. The pig is seen to be more plastic to the moulding influence of food than has been supposed. So far as the pig is concerned, it appears that we may elect, largely, the type of meat that we will eat.

The Department of Agriculture at Washington, as heretofore, kindly performed the analyses of the foods given to the pigs fed in the following tests:

ANALYSES.

	Corn.	Blood.	Shipstuff.
Moisture	10.43 per cent.	20.78 per cent.	15.20 per cent.
Ash	1.57 "	6.65 "	3.65 "
Fat	4.51 "	2.14 "	4.41 "
Carbohydrates (undetermined)	74.39 "	2.87 "	57.99 "
Crude Fibre	1.92 "	..... "	2.62 "
Nitrogen	1.15 "	10.81 "	2.58 "
Albuminoids	7.18 "	67.56 "	16.13 "

The shipstuff is what is known as middlings in other sections, but is sold here as shipstuff.

From July 2nd, when the four pigs of each lot averaged in weight 55 lbs. each, lot two was fed wholly on corn meal or occasionally on whole corn, while lot one was fed on four parts shipstuff and one part blood. Previous to this period lot two was fed on corn and lot one on shipstuff; each ration was moistened with cold water. In accordance with eight years weighings, shipstuff again proved a better food than corn meal. Lot two had to be kept a short while after lot one was slaughtered to gain the same weight of lot one and the same degree of ripeness.

The digestible nutritive ratios were, for lot one as 1 to 1.8; for lot two as 1 to 12.8.

For the theoretical functions of these food nutrients, as usually understood, I will refer to Bulletin No. 14 in possession of most of those who will receive this number.

COMPOSITION OF THE PIGS.

The external fat of the pigs was separated from the lean by the most painstaking use of the knife, about two days being devoted to a pig to make the work accurate. The following table gives the results:

	Shipstuff & Blood No. 1 of lot I.		Corn meal No. 1 of lot II.		Shipstuff & Blood, No. 2 of lot I.		Corn meal No. 2 of lot II.	
	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.
Live weight of pig	138	6¼	139	15	170	4½	170	14¾
Heart		7½		7		8½		10
Lungs	1	9½	1	15½	1	15½	1	13½
Liver	3	3	2	5½	4	¼	2	9
Spleen		2¾		2½		3½		3
Kidneys		8½		4½		8½		5½
Leaf	2	2	5	4½	4	10	7	13½
Paunch	6	4	5	4	5	14	7	8
Intestines	12	10	10	8	11	12½	11	
Fat of intestines	2	10	4	5	3	12½	4	
Brains		4½		3½		4¼		4¾
Fat of body	38	14	46	4	50	3	70	1½
Lean and bone	64		58	4	79		57	11
Hair		11		9½		13		11
Blood and loss in cooling	4	15½	4	1¼	6	11	6	
Per ct. of external fat to live weight	31.5 per ct.		39.9 per ct.		34.6 per ct.		47.9 per ct.	
Per ct. of external fat to lean and bone	68.0 "		95.8 "		75.4 "		160.8 "	

Increased per cent. of external fat of lot one (both pigs) over fat of lot two (both pigs) 33.0 per cent.

On the above data, I will note the following facts:

I. That the increase of fat, while at every point noted in the carbonaceous (corn fed) pigs, is not so great as was found in the previous two years work. This is due to the fact that the pigs were not as fat in either lot as in the previous years. Slow growth of the corn fed pigs has given less difference in fat than good growth, as would be expected.

II. Certain of the vital organs, as last year, weigh more after the albuminous foods than after the carbonaceeus foods. The kidneys are a notable example of this fact, which fact will doubtless be explained by physiologist, who have noticed the influence of albuminous foods in the excretion of urea. The spleen and liver weigh less in lot one than in lot two, as last year. Thus it would seem more than probable that

the kind of food given modifies the constitution and functions of the vital organs. We cannot doubt that this influence on these organs has important relations.

III. The greater proportion of hair on lot one peculiarly emphasizes the observed influence of food on the character of growth. Hair is albuminous and thus even the hair on the albuminous food fed pigs is greater than on the corn (carbonaceous) fed pigs.

IV. There is no difference found in the weight of the dressed carcasses of lot one and lot two. Thus the question is clearly answered, as to whether the pigs without so-called fattening foods get equally fitted for market. The only difference in the carcass is that one is more than one half lean meat while the other is less than one-half lean meat, when bone is excluded, as will be soon seen.

ANALYSES OF THE FLESH.

Prof. Paul Schweitzer, Prof. of Chemistry of this College, who takes much interest in agricultural chemistry, has very kindly aided this work, contributing 14 analyses of the flesh of the pigs. Heretofore in this experiment we have been dealing only with the fat that could be separated with the knife. In No. one of each lot I took sections of flesh from the surface of each part named, in the same spot for each animal.

	Shoulder, Loin, Thigh.			Shoulder, Loin, Thigh.		
	No. one of lot one.			No. two of lot two.		
Water	67.72	66.25	63.60	68.24	62.60	64.27
Fat	7.97	5.35	7.30	10.20	14.02	13.32
Ash	1.43	1.27	1.62	1.31	1.02	1.49
Rest, chiefly albuminoids	22.88	27.48	27.48	20.19	20.19	23.92

The selections in Nos. two of lot one and two were made in deeper sections of each part than were made of Nos. 1 of each lot, with a purpose to get an average sample of each part and thus be able to obtain the absolute amount of fat among the fibres of the flesh. For this purpose the lean meat of each section was weighed and finally the bones were weighed, as an accompanying table will show. I will condense the several analyses of No. two of each lot into averages.

	No. Two of Lot One.	No. Two of Lot Two.
	Average of loin, shoulder and thigh.	Average of loin, shoulder and thigh.
Water	67.58 per cent.	62.22 per cent.
Fat	9.54 "	16.55 "
Ash	1.19 "	.97 "
Rest, chiefly albuminoids	21.69 "	20.26 "

Analyses of other parts mostly trimmings of bones and flank and neck gave, as average of tests.

Water	61.74 per cent.	58.09 per cent.
Fat	17.21 "	20.08 "
Ash	.60 "	1.10 "
Albuminoids, as before	20.44 "	20.71 "

Future investigators will doubtless find a little less difference in the fat of loin, thigh and shoulder, and more in the trimming, etc., of the two lots than is given in the last two tables of analyses. I selected my samples on different days separated briefly in time, and probably did not get precisely similar samples, although endeavoring to do so, impartially.

Prof. Schweitzer has figured out the ratio shown by his analyses of fat to rest (albuminoids), which markedly illustrates the radical influence of food on the composition of the lean meat of pigs.

	Fat to Albuminoids. Lot 1, Feed, Blood and Shipstuff.	Fat to Albuminoids. Lot 2, Feed, Corn.
	1 to 2.87	1 to 1.96
	1 to 5.07	1 to 2.32
	1 to 3.76	1 to 1.60
	1 to 1.83	1 to .82
	1 to 1.61	1 to 1.38
	1 to 5.03	1 to 1.22
	1 to 3.67	1 to 1.03
Average	1 to 3.40	1 to 1.47

I. Quite as wide a variation is found in the ratio of fat to albuminoids in the flesh as is found in the variation of layer fat to the whole beast due to food.

II. The percentage of albuminoids is less varriable in the flesh than the fat is. The large proportions of fat in the flesh are found in connection with a diminished proportion of water.

WEIGHT OF FLESH.

	Pig two of lot one.	Pig two of lot two.
Weight of flesh of thighs	15 lbs. 4 ozs.	12 lbs. 00 ozs.
" " loins	12 lbs. 14 "	10 lbs. 14 "
" " shoulders	10 lbs. 11 "	6 lbs. 12 "
" " head	3 lbs. 7 "	2 lbs. 11½ "
" " trimmings		
" " ribs and thighs		
" " shoulders, etc	22 lbs. 3 "	13 lbs. 11 "
Weight of bones	14 lbs. 8 "	11 lbs. 11 "
Total lean meat	64 lbs. 7 "	46 lbs. ½ "

Although the pigs were of the same live weight, lot one (that is albuminoid fed lot) has 40 per cent. more lean than has lot two.

By applying the rate per cent. of fat to lean, as given in a previous table, we get 8.1 lbs. fat from the lean meat of lot 1 and 8.24 lbs. from the much lesser amount of lean meat of lot two, or in percentage the proportion of fat of the flesh of lot two is 43.2 per cent. more than is found in lot one.

The total amount of fat, aside from that in the offal and without making analyses of the skin and leaf, for pigs two of each lot is for lot one 66 lbs. 11 ozs.; for lot two 90 lbs. 2 ozs. The latter amount is 35.1 per cent. greater than the former, and equal to 52.7 per cent. of the total weight of the corn fed pig, which is 12 per cent. more fat than is given as the German average. Indeed our shipstuff fed pig carried 39.1 per cent. fat to whole carcass which is but one per cent. short of the above named average.

Viewing pig two, corn fed, we find we get almost two lbs. of fat for every one of lean meat. No wonder that American wealth is disgusted with American hog grease, as a daily food and year by year steadily consumes less and less of it, as shown in a former bulletin.

I. It will be noticed that this particular hog, whose bones were carefully stripped, had less bone than the shipstuff pig. Corn is almost devoid of lime.

II. I am satisfied from the three years work now concluded, that from 40 to 50 per cent. variation in fat by the food given can be made in the composition of a pig.

III. The block is no test of breed influence on the character of meat made unless measured by the character of food given, and Fat Stock Shows should govern their premiums and requirements accordingly.

IV. Albuminoids do not prove the ready fat formers in these trials that physiologists have supposed them to be.

V. Carbohydrates are fat formers with pig No. two, fed with corn.

VI. I would be delighted to carry on investigations of this nature, so important to the interests of our people, on a much broader scale than is now possible, were adequate provisions made for doing so. There is no virtue in any particular locality for this work, and it can be done right here as well as any where in our State or country. Our State farm should be provided without delay with a generous outfit, as the result would be a prompt and large return to the State.

Respectfully submitted,

J. W. SANBORN.

P. S.—I overlooked noticing in its proper place that Professor Schweitzer observed a distinct difference in the color of the fat of the fibre of the pigs of the two lots, lot one having a darker colored fat. Attention will be directed to this point in the future.

BULLETIN NO. 20.

S. S. LAWS, LL. D.: I hereby submit to you a report of Prof. L. R. Taft of his investigations and observations in the Horticultural Department under his charge.

Very respectfully,
J. W. SANBORN.

HORTICULTURAL DEPARTMENT,
MISSOURI AGRICULTURAL COLLEGE,
COLUMBIA, MO., March 1, 1886.

PROF. J. W. SANBORN, *Dean Missouri Agricultural College:*

SIR: Owing to the fact that this department is obliged to depend for its support upon the sale of its products, it was not deemed advisable to attempt any elaborate experiments or scientific investigations.

A large number of the new and standard fruits and vegetables were grown on the grounds, and throughout the year careful observations were taken, with the view of determining the comparative merits of the different varieties in the soil and climate of Missouri.

SMALL FRUITS.

Raspberries.—Of the red varieties, Turner, Thwack and Shaffers Colossal, are hardy and productive, and were the only ones that were profitable. Caroline, Cuthbert, Brandywine, Reliance, Superb and others, were failures. Hansell does not stand our climate. Marlboro wintered perfectly, but was too young to fruit.

Hopkins and Gregg, blackcaps, winter killed badly, owing to a late growth, but some of the vines gave a good crop. Tyler, Wetherbee and Souhegan were but slightly injured by the winter, and gave a fair crop.

Blackberries.—The crop of fruit failed, but the vines themselves came through almost perfectly. For hardiness alone, they ranked as follows, viz.: Snyder, Taylors, Prolific, Western Triumph, Kittatinny and Early Harvest. No rust was seen at any time.

Early Cluster, Wilson Junior and Agawam were added to the collection during the year, and all promise well so far as hardiness is concerned.

Strawberries.—Over fifty varieties of strawberries were grown, mostly in small quantities, merely to test their value.

The plants were set partly in 1883, and partly in 1884, and had received but ordinary cultivation in matted rows.

The most profitable varieties were Crescent Seedling, Cumberland Triumph and Capt. Jack. They seem well adapted to all parts of the State, and for cultivation in the matted row are equalled by no other variety. They are hardy, vigorous and productive, and the fruit is of good quality and handsome in appearance.

The Crescent sets a vast number of berries which dwindle in size towards the last of the season.

Crystal City is one of the earliest varieties tested, but the berries are soft, and far between. Atlantic and Daniel Boone proved strong and vigorous in growth, but they matured a light crop.

Bidwell and Pipers Seedling, set a full crop but were unable to carry it out.

Sharpless has large, light green glossy leaves which are quite free from rust. The berries are borne on slender fruit stalks and generally rest on the ground. The upper side being exposed to the sun ripens several days in advance of the under, and often decays before the lower side is ripe. The fruit is always misshapen, and from this fact the name of Shapeless has sometimes been applied to the variety.

Hart's Minnesota is a good grower, ripens medium to late, and can be depended upon to produce a fair amount of fruit, regular in shape, even in size and of good quality.

Miners Prolific possesses the good qualities of the Sharpless, and none of the poor ones, but it is not sufficiently productive to warrant the extensive planting of the variety.

Jersey Queen and Manchester are excellent late varieties in the hands of an amateur. For ordinary planting they cannot be recommended, as without the best of care and attention they do not bear remunerative crops. If grown in hills and properly manured and cultivated, they will furnish large crops of magnificent berries.

Jas. Vick and Longfellow should only be grown in hills, and even then will be found far less reliable than many of the others.

The Chas. Downing and Wilson *have been* our most reliable varieties, but owing to their rusting badly, they are of less value than formerly.

Daisy produces fruit of fine quality, but it has always shown itself a shy bearer. Mrs. Garfield and Big Bob were fair growers, but only produced a few fair sized berries.

Evarts Favorite is another of the new varieties, and from its vigorous growth, productiveness and the fine quality of fruit, it promises to be a valuable acquisition.

Of the new varieties which have not fruited, May King, Parry, Henderson, Emerald, Jewell, Woodhouse Seedling, and Southards Nos. 1 and 2 promise the best results.

GRAPES.

The experimental vineyards contain about fifty varieties in bearing, and forty new varieties which have not fruited.

The land occupied by them is wet and poorly drained and the hardiness of the varieties has been severely tested by the extremely low temperatures of the last two winters.

The varieties which have shown themselvs to be *ironclad* are Concord, Elvira, Uhland, Moores Early, Telegraph, Martha, Ives, Bloods Black, Pocklington, Worden, Lady, Champion, Venango and a number of others less known.

Of the varieties that were killed to the ground, Goethe, Massasoit, Wilder, Salem, Agawam, Essex, Rogers Nos. 2 and 8, Delaware, Brighton, Duchess, Lady Washington and Vergennes may be mentioned.

The *grape rot* attacked to a greater or less extent nearly all of the varieties. Beginning with Telegraph, which was worst, they gradually improved through the following varieties, viz.: Uhland, Bloods Black, Champion, Lady, Ives, Venango, Pocklington, Moores Early, Worden, Concord, Martha and Elvira, the last being but little injured.

While the amateur can lay down his vines during the winter, and thus prevent their winter killing, and can guard against the rot by bagging, the ordinary farmer who cannot, or will not, do this, should choose such varieties as will withstand our winters and will be, in a measure, secure from the rot.

The Moores Early and Ives for early varieties, Concord and Worden for medium, and Martha and Elvira for late, will furnish as good a selection as can be made for hardiness and fredom from rot.

VEGETABLES.

Seeds of standard varieties, and of the so-called novelties, were obtained from a large number of the most prominent seed-growers and seed-dealers, in order to ascertain the comparative reliability of the seeds sold by the different firms, and determine the value of the different varities for the Missouri farmer and gardener.

The seed from firms which are *seed growers* gave good results, both as concerned its powers of germination, and being true to name. From ten to thirty varieties from each firm were carefully tested, and Gregory, Landreth and Sibley lead the list so far as germination was concerned, with several other firms close behind them. With few exceptions the per cent. of germination was very high, and in no case was it, untrue to name.

With the seed obtained from *seed dealers* it was different. Several varieties did not germinate at all, and others proved to be badly mixed, or were of varities utterly unlike what they claimed to be. The following seemed best adapted for ordinary cultivation :

Beans, bush.—For very early Wax varieties, the Dwarf, German Wax, Golden Wax and the Yellow Six Weeks, gave the best results. Early Valentine and Dwarf Horticultural are very productive and may be used for string beans, or can be shelled and cooked either green or dry. *Pole.*—Of the running varieties the Southern Prolific, in productiveness, is unequalled. Dreers Improved Lima is better in quality and is nearly as productive. These require a long season and will not mature at the north. The Pole Horticultural, Sieva and Lima ripen arlier, and are excellent varieties.

Beet.—The new Eclipse takes first rank, surpassing the Egyptian, which it rivals in earliness, color and smoothness. Instead of being flat like the Egyptian, it is round and has a small top.

Following these come Extra Early Bassano, Bastians Half Long, and Dewings Early Blood Turnip.

Cabbage.—Of the early cabbages none succeeded as well as the Early Jersey Wakefield, although Landreths Earliest and Early York were early and approached it in size.

For the second early Hendersons Early Summer and Fottlers Brunswick have no equal. Of the late sorts, Stone Mason and Flat Dutch are perhaps best.

Cauliflower.—The Early Dwarf Erfurt is the surest to head in this climate, and Hendersons Early Snowball generally does well.

Celery.—For marketing in the early fall, the Early Arlington promises well. The White Plume is rather tender and a poor keeper.

Unless banked, it lacks the crispness and nutty flavor which characterize some of the other varieties.

Boston Market rusted badly, but is still one of the standard varieties. Golden Dwarf and Crawfords Half Dwarf generally do well. The pink varieties are good growers and are quite popular in some markets.

Sugar Corn.—The Cory ripens earliest and is as large as the Crosby. Early Marblehead has a small ear, but is one of the very earliest.

Early Minnesota, Crosby's Early and Moore's Early Concord are larger and follow in succession.

Stowell's Evergreen, Egyptian and Mammoth Evergreen are standard late kinds, and if sown at propor intervals will prolong the season until frost comes.

Cucumber.—For forcing, Early White Spine and Early Frame are excellent varieties.

Early Cluster and Early Russian are among the earliest and are quite productive. Long Green and Tailbys answer well for slicing, and the Green Prolific for small pickles.

Lettuce.—Boston Market is one of the best for growing in the green house or hot bed. For cold frames and early out of door culture Early Silesia and Early Simpson do well. Hanson and Salamander stand the warm weather and are unsurpassed for summer growing.

Onions.—The Bloomsdale Pearl, and Silver Skin are among the best for early, and for the main crop Danvers Yellow and Wethersfield Red are heavy croppers and sell readily.

Parsnip.—The Student and Hollow Crown are sweet and productive.

Peas.—Landreths Extra Early, Sibleys First and Best, and the "earliest of all" varieties of several other firms, were planted in adjoining rows, and at no time during their growth could any difference be detected. They were early and productive. For second early, Bliss American Wonder is to be recommended. If the seed is true and proper cultivation is given they will prove very productive. Carters Premium Gem and Stratagem, are both good medium early varieties. Horsford's Market Garden pea will, from the same amount of seed, outbear any other variety. For late varieties Champion of England, and Black Eyed Marrowfat are without equals.

Potatoes.—Seed of twenty-six varieties was obtained, and one hundred hills of each sort were planted in adjoining rows. One side of the piece was low and flat, and owing to the extremely wet season, the potatoes at the end of all the rows decayed, but no rot was seen

except in the spots where the water stood for several days on the surface. It was therefore found necessary to approximate the yield, from the number of hills remaining in each row.

The early varieties were dug as soon as they were sufficiently grown, but the late kinds were left in the ground until the vines were dead.

The approximate yield per acre of the early varieties was as follows, viz.: Early Ohio 270 bushels, Early Illinois 285 bushels, Early Telephone 255 bu., Early Gem 265 bu., Early Sunrise 275 bu., Early Mayflower 190 bu., Beauty of Hebron 270 bu., Early Harvest 300 bu., Early Maine 253 bu., Clarks No. 1 258 bu., Lee's Favorite 260 bu., and Early Rose 175 bushels.

Early Harvest was from six to eight days earlier than Early Ohio, which was nearly a week ahead of Clarks or Beauty of Hebron.

The order of ripening was: Early Harvest, Early Sunrise, Early Gem, Early Illinois, Early Ohio, Early Mayflower, Early Maine, Lee's Favorite, Clarks, Beauty of Hebron, Early Rose and Telephone.

Of the late varieties, Rural Blush leads off with 325 bu. per acre, followed by Dakota Red,322 bu., White Star 319 bu., White Elephant 315 bu., American Giant 300 bu., Corliss Matchless 295 bu., Queen of the Valley 294 bu., Mammoth Pearl 291 bu., Brownells Best 280 bu., Blue Victor 275 bu., Garfield 240 bu., Jumbo 232 bu., Peachblow 205 bu., and Burbank 170 bushels

Of the early varieties Early Harvest and Early Sunrise were best in quality, and Rural Blush, White Star, and Brownells Best of the late.

Radishes.—Beckerts Chartier deserves first place. This with French Breakfast, Scarlet Olive, and Covent Garden, with White Olive for late makes up a good variety.

Squash.—The Summer Crookneck and White Bush succeed well for early, followed by Pine Apple, and Essex Hybrid. For winter, Boston, Marrow, Hubbard, and Olive as a late keeper.

Tomatoes.—Acme, Paragon, Perfection, Trophy and Livingstons Favorite are all good varieties. The new Cardinal excels as a late variety.

Turnip.—Of the varieties of turnip, the Early Purple Top and White Egg are best, with the White or Yellow Globe for late.

For ordinary garden culture it is unwise to grow a great number of varieties. Select a few of the best varieties which ripen in succession, and if possible, plant in long rows that can be cultivated with the horse.

Respectfully submitted,

L. R. TAFT.

BULLETIN NO. 22.

CORN HARVESTING.

SEASONABLE SUGGESTIONS.

MISSOURI AGRICULTURAL COLLEGE,
COLUMBIA, July 22, 1886.

S. S. LAWS, LL. D.

SIR: In Bulletin No. 11, I gave the result of experiment work in feeding corn fodder harvested while the corn was passing out of the dough state. A few farmers have made a trial of the system stated in the Bulletin alluded to, while I learn that an increased number will test the system this fall; yet the great bulk of our 8,000,000 tons of corn foddder is either not used or used to little purpose, corn growers adhering to the notion that they cannot afford the expense of its right use. After years of somewhat exact work, I feel that I am fully justified in saying authoritatively that our corn fodder can thus be secured at much profit. Our 106 acres, exclusive of pasture and woods, are devoted to general farming in the following rotation: Corn, oats, clover, wheat, timothy. Thus we have just one-half of our land in straw and corn fodder crops. During the rough winter of 1885–6 our stock made a gain on these foods; that is, hay and stover and corn fodder without grain—the corn fodder and straw being all fed out. As the stock of the State fed on hay without these poorer foods—straw and corn fodder—lose weight without grain feeding; the success of our system of using our corn fodder will perhaps be better appreciated than by the statement of exact trials made by me, and which are positive on the point. A good acre of corn fodder will keep tenfold the stock now averaged to be fed upon it. This fodder can be saved and put into stacks, as related in Bulletin 11, for about $2 per acre. Every acre saved of good corn fodder will add a steer to the number now kept. I have again thus briefly generalized, because of the immense sum involved and the great possibilities in our wasted corn fodder.

WHEN HARVEST.

Trials with flint corn have always given me as much corn when it is put into shocks at the glazing period as when allowed to ripen on the stalk. The method of maturing the Dent corns, as Dr. Sturtevant has asserted, seems to be different from the ripening off of the flints. My experience seems to show that the Dent must be well dried to the center before cutting up the stalk, if full weight of corn is to be gotten.

In 1883 a brief trial gave for 100 hills in the milk stage, 83 lbs corn; when beginning to harden, 123 lbs—stalks and leaves yet green; when fully ripe, 121½ lbs.

In 1884 I cut three lots of four rows, each 28 rods long. The first lot was cut September 6, while milky juice was found in the kernels, tip kernels glazing a little. The second lot was cut September 13. It had ripened rapidly and the kernels were dry throughout, save at the end where milky juice was yet seen. The leaves were turning some. The third lot was allowed to ripen on the stalk.

Lot.	Weight of corn.	Weight of stalk.
1.	564½ lbs.	559 lbs.
2.	676 1-5 lbs.	660 lbs.
3.	795¾ lbs.	830 lbs.

A lot of each corn was put up to dry—37 pounds was used. It was weighed after it was fit to bin in our narrow bins of 4 feet, that are used for shocked corn that is early cut. Time of drying, to September 4, of next year.

Lot 1 lost 30.4 per cent.; lot 2, 36.7 per cent.; lot 3, 29.4 per cent.

The shrinkage of lot 3 was that of fully ripe corn. A little calculation will show that with shrinkage 29.4 per cent., interest 8 per cent. and 2 per cent. risk and loss by vermin, corn worth 30 cents a bushel at harvest would have to bring 46.7 cents one year after to make the owner even, provided he sells the corn. This is 55.6 per cent. increase in sale value. Peculiarity of seasons will change this ratio. I may say that with Flint corn, several years since, I received fully as marked results.

We got, of dry corn by the several methods, as follows: Lot 1, 390 lbs.; lot 2, 416 lbs.; lot 3, 585 lbs. These lots, 1 and 2, were by these figures cut too early.

TRIAL OF 1885.

Cut 4 long rows when corn was drying out, but yet in dough state to wit: September 5. September 15 cut 4 rows, out of dough state and leaves drying. Four rows left to ripen. All were husked September 29. Lot 1 gave 907 lbs. corn; lot 2, 1,070 lbs. and lot 3, 1,086 lbs. corn.

I am satisfied that Dent corn cannot be cut quite as early in the apparent stage of maturity as Flint corn. It is a little more difficult to determine this period with the Dent corn than with the Flint, as the latter gives a ready index in its glazing.

To the best of my judgment, Dent corn should not be cut until the kernel is fully out of the dough state and crushes dry. This will be at a period when the leaves are dryer than I would prefer to cut them for feed, yet early enough to furnish a palatable food if carried soon to the stack. Last year our corn was all housed away in bins 4 feet in width, and our corn fodder was all in the stack by October 20. This fall I shall look more critically into this question.

SELECTION OF CORN.

Notwithstanding the importance of corn fodder, we should bear in mind in raising field corn that the prime object sought is the kernel. To the purpose of raising the largest ratio of corn to fodder we should devote our care. This aim is of most importance to the corn grower who sells the corn and makes little use of the fodder. Large stalks force thin planting. Close planting is nearly demonstrated to be the method for large yields. Believing that the corn plant can be modified in its stalk by breeding or by selection as well as a steer can, I made the following test trials:

FOR 1883.

Yield of corn selected from stalk 12½ feet high, 30.39 bushels per acre, and the stover weighed 3,152 lbs. per acre. Yield of corn from stalks, 9½ feet tall, 32.97 bushels, and stover, 2,144 lbs. per acre.

FOR 1884.

Yield of corn from selected tall stalks, 32.8 bushels, and stover, 4,700 lbs. per acre. Yield of corn from selected short stalks, 45.7 bushels, and stover, 3,400 lbs.

FOR 1885.

Having overlooked the selection of corn from tall stalks in the fall of 1884, I took good ears from the bin and planted them against corn from short stalks, thus planting corn from short stalks against the average corn of the field. Here I may explain that I select my seed corn from standing corn in the field before it is cut. When the typical style of ear and plant are found, the plant is cut up and the ear allowed to ripen from the stalk. Selection is thus made from the field in order to observe the character of the plant, which is regarded as of quite as much importance as the character of the ear.

Yield of seed of bin-selected corn, 38.3 bushels; yield of fodder, 5,250 lbs. Yield of corn from short stalks, 47.3 bushels, and of fodder, 4,500 lbs. per acre.

Arranging these yields by average results of three years, we have:

	Bushels.	Stover lbs.	Stalks to bu. corn.
Yield from tall stalks	38.8	4,367	129.2lbs.
Yield from short stalks	41.9	3,348	79.9lbs.

This result is more marked than I expected, giving 38 per cent. less stalks and 24 per cent. more corn than the larger plants. It will be observed that the total number of lbs. of corn and stalks to the acre is less with the selected small stalks than with the large stalks. One purpose to be accomplished by smaller plants is close planting. I did not take advantage of this reduction in size of plant to plant closer, as it would introduce a disturbing element whose force I could not measure. I have no doubt that the total yield would have been about equal by close planting of the corn from short stalks, while the ratio of corn to stalks would have been again changed. How far this factor in selection can be pushed cannot be stated, but that it is a valuable working factor I have no doubt. With this belief I have so selected, and plant our corn closer than is common.

CROSSING CORN.

This trial is not so timely as the preceding, but comes under the head of corn breeding. The plant also stood by the side of those where results were just given for 1885.

The principle involved is the old one of in-breeding, so fully debated in stock breeding and those thoroughly discussed by Darwin in

plant life. Crossing plants has proven almost universally either favorable or neutral in results. No crossed plants giving poorer results than inbred plants, at least is so, so far as I have seen the results. I crossed the Snowflake upon the Thompson corn in 1884. Both of these varieties are white. The Thompson has a little longer ear and deeper kernel than the Snowflake, but is not widely dissimilar.

The crossbred Thompson corn yielded in 1885, 54 bushels corn and 7,391 lbs. stover or corn fodder. Pure Thompson corn gave 38.3 bushels corn and 5,250 lbs. stalk. The Thompson selected from short stalks in the field gave, as seen, 47.3 bushels and 4,500 lbs. stover. As this is in agreement with other results, and in accord with what I deem to be a general law, I feel satisfied that our corn growers have within their easy reach a means of greatly increasing their corn crop. The cross is easily made by planting alternate rows of the varieties to be crossed, and at the proper time before the pollen ripens, pulling the tassels from the row to be crossed upon. This, of course, needs to be done only on a small area for seed. The varieties crossed should be somewhat similar and ripen nearly together. The cross for seed should be made each year between the pure types for the best results.

VARIETIES OF WHEAT.

The College Farm has sown quite a number of varieties of wheat each year for several years. I have but little faith in tests of varieties for the farmers of the State. While the results may benefit some they are equally liable to mislead others. In these remarks I except the value of the tests of new sorts whereby a general knowledge may be obtained, of an unknown kind. Soil, local climatic conditions, and artificial treatment determine the varieties to be grown. A study of the trials of varieties of the various farm and garden crops made at various points in the country will reveal great variations in results, and at the same points these variations are great between the seasons.

The Fultz, among 150 varieties tried here, has been retained for field use as our best wheat for upland soil, when all points are considered. The Clawson, Bennett, White Rogers, Sparks Swamp or Mediteranean have proven to be great yielders on this soil. Each one of these on the score of yield rank as the best with us, although no better than the Fultz for the average year. The Sparks Swamp is bearded and lodges, the White Rogers is bearded and is not so much in favor with the millers as the Fultz. The same trouble with the millers is experienced with the Clawson, although it is growing darker in color and harder here, as the Fultz did after its introduction. For the reasons given, I make no extended remarks on varieties of wheat.

I occasionally hear it remarked that the Fultz is running out. My experience leads me to believe that it is the farm and sometimes the farmer that is running out. At the College Farm we select the heaviest, plumpest seed, rotate our crops, following clover by wheat and yard our cattle and manure our crops. The result on our Fultz wheat is as follows: The first crop that I cut was being sown when I took charge, four years ago. It made ten bushels of wheat per acre in a poor year. The second crop had two favorable changes, a better season and partial change of system of farming; crop, twenty-two bushels. The third crop was under a fuller change of system and upon one of the worst wheat seasons known to Missouri; crop, seventeen bushels. State average, something over seven bushels. Crop this year, 31½ bushels per acre. The full establishment of the system of farming proposed will require six years to complete, when 40 bushels per acre is looked for in an average year, with the confidence of certainty. Indeed the crop of wheat this year on the section of ground not following very close in point of time to wheat was nearly 40 bushels per acre. Our best wheats have run out in the State with the gradual decline of the wheat crop of the State from 25 bushels to 11½ bushels per acre, our average of the last ten years. We can run wheat in again by running our fertility back.

During 1884 I sent a circular of inquiry to a large number of farmers, including every county in the State. Seventy-one named Fultz as the best variety, twenty-six favored the Mediteranean and eight the May wheats, while many other varieties had from one to five votes each. Fultz was particlurly favored for upland fields.

Of several new sorts growing on the College grounds none promise to supplant the Fultz for this farm.

Anyone wishing a copy of these bulletins as they are issued will receive them by sending in their name.

Very respectfully submitted,

J. W. SANBORN.

BULLETIN NO. 23.

RELATION OF DEW TO SOIL MOISTURE.

STATE FARM, COLUMBIA, MO., Aug. 31, 1886.

S. S. LAWS. LL. D. *President Agricultural College and University of Missouri:*

SIR: In the year 1885 I published in Bulletin No. 6 the results of several direct tests by different methods, of the amounts of moisture found in the soil at night and in the morning. The principal direct method consisted of ascertaining the amount of moisture in the soil of cylinders of earth in their natural position, but with the capillary water from the under soil shut off from rising by bottoms inserted into the cylinders of earth. The several methods tried and reported in the above named bulletin gave one result. I will sum up the evidence in the following statements:

1. Generally, more water was found in the second two inches of soil than in the first two inches, both during the day and during the night; whereas, if the soil gained moisture at night there should be more water in the surface soil in the morning.

2. On some mornings, and only during a very humid atmosphere, the surface soil contained as much, and in one case more, moisture than the subsoil, thus showing that when evaporation was checked capillary action caught up with evaporation and shows that surface soil should contain as much or more misture, if it gained it at night from the air, as both capillary action and the air would be filling the surface soil.

3. Both surface and under soil contained, to the depth of 6 inches, more water in the morning than at night—but as the upper and under soil gained moisture nearly relatively, the moisture must have come from the deeper soil, otherwise the surface soil would have gained much the most.

4. There was more moisture in the surface soil in the morning of a fog that moistened clothes, showing that moisture is greater in surface soil than in the under soil when it is actually gained from the air.

5. When the surface of the soil was hoed shallow, it gave less moiture than when left untilled; whereas, by the usual view it should contain more water. In this case tillage checked capillary action from bringing the usual amount of moisture from below, while none was gained from above.

6. I found more moisture in a covered soil than in a bare soil; whereas, if the soil gains moisture from the air the reverse should be the case.

7. Finally, when capillary action was shut off from cylinders of earth in their natural position by having a bottom inserted in the cylinder by digging down at one side, there was found less moisture in the enclosed soil, showing that the gain of water in the surface soil at night came from beneath.

Thus I conclude that soils usually lose moisture by night as a general rule that admits of exceptions, as will be shown in this paper.

For the last three seasons I have carried on a few tests each year. They are corroboratory of the propositions laid down, showing, however, that soils do gain moisture under certain conditions that will be briefly stated.

I will now give the data of each year in a brief tabular form, so far as it admits of tabulation. A considerable evidence will be omitted that is corrobboratory but not in a form to tabulate:

Season of 1883	Humidity	Dew point	Temperature of Air	Sensible Temperature.	Weight of Air	Soil temperature	1st two in. of natural soil lost in water	2d layer of natural soil lost in water	Soil hoed night before, lost	Pipe closed at bottom, 1st two inches lost	Pipe closed at bottom, 2d two inches lost	Remarks.
P. M. Sept. 12	37	69	68	60½	3.1	72	5.8	8.7	4.6	....	....	Test at close of drouth of 30 days.
A. M. " 13	73	57	56	51½	3.7	57	7.9	10.0	6.6	....	....	
P. M. " 13	48	50	74	60.5	4.5	76	6.0	12.5	....	....	....	
A. M. " 14	80	62	62	58.5	....	62	7.3	13.3	....	5.9	10.4	
P. M. " 18	54	68.6	68	51.5	....	72	5.4*	....	....	....	....	*Taken at 3 in. deep
A. M. " 19	93	56	56	54.5	....	59	7 *	....	6.8	5.1*	....	*Rained very little on night of 21st.
P. M. " 25	74	56	56	....	3.7	65	4.1*	....	....	....	....	
A. M. " 26	90	45	45	43	4.2	....	8.5	....	7.5	5.6	....	
P. M. Oct. 16	....	....	....	....	....	....	12.3	....	....	....	....	After rains.
A. M. " 17	72	....	....	....	....	....	15.6	....	....	18.5	....	Very heavy dew.
P. M. " 18	72	70	66	63.5	5.7	....	21.2	21.6	22.4	....	....	Soil covered by dew.
A. M. " 19	94	58	58	67.5	4.1	57	24.2	....	21.6	23.2	21.2	Fog sufficient to moisten clothes.
P. M. " 19	....	....	....	....	....	....	20.8	21.2	....	....	....	
A. M. " 20	....	....	....	....	....	....	23.6	22.8	....	....	....	
P. M. " 31	62	44	44.5	44	3.5	....	24.1	24.1	24.1	24.0	....	
A. M. Nov. 1	....	....	....	....	....	....	24.1	24.1	24.1	24.1	....	

REVIEW OF TABLES.

The 13th day shows that the hoed surface compared with the subsoil, did not gain as much as the unhoed surface, whereas, it should have gained more by the dew theory heretofore held. This was true of every case, save Nov. 1st, when the natural soil showed no gain in the morning over the night. Two per cent. less water is shown in the closed pipe in the morning than in the open soil. This shows that the soil in the natural condition must have gotten its increase of moisture found in the morning, from the subsoil by capillary action.

Dry for 10 days after a rather moist soil. Trial in open lot.

	Wet bulb temperature.	Dry bulb temperature.	Surface soil, temp... bulb, just covered..	Grass soil, surface temperature..	Temperature 3 inches deep.....	Surface soil in natural condition.....	Water in six inches of natural soil.....	Water in surface, soil enclosed.....	Water in six inches of soil enclosed.....	Temperature one foot above ground.....	Temperature of soil 2 inches deep.....	Air Temp. just over surface.....	Remarks.
P. M. July 1.....						* 15.8	† 20.2						
A. M. " 2.....						* 17.9	† 21.5	13.9	20.4				
P. M. " 4.....	76	76	78	78	78	* 24 5	† 24.5	....	....	78			
A. M. " 5.....	62	68	72	72	....	.....	† 23.5	....	23.5	....	72	....	Night slightly cloudy, some dew.
P. M. " 11.....						....	† 15.0	....	....				
A. M. " 12.....						.....	† 15.9	....	16.2				Night cold, heavy dew.
P. M. " 11.....	69	86	80	....	....	*13.19	†13.45	....	....	82	....	78	
A. M. " 12.....			59	58	....	*13.09	†13.37	....	....	62	....	52	
P. M. " 13.....					....	*10.36	†13.30	....	....				
A. M. " 14.....					....	*10.27	†13.27	....	....	....	....	....	Dew fell.
P. M. " 14.....					....	*10.83	†13.09	....	....	....	....	....	
A. M. " 15.....					....	*10.83	†13.22	....	....	....	....	....	Heavy dew.
P. M. " 15.....					....	*10.90	†13.03	....	....	....	....	....	
A. M. " 16.....					....	*10.90	†13.03	....	....	....	....	....	Good dew.
P. M. " 17.....					....	*13.08	†14.87	....	....	....	....	....	Rain 17th.
A. M. " 18.....					....	*13.03	†14.57	....	....	....	....	....	
P. M. " 20.....					....	*15.03	†15.37	....	....	....	....	....	
A. M. " 21.....					....	*15.06	†15.37	....	....	....	....	....	Rain.

After this date the boxes of earth were weighed on the scales direct.
Box No. 1 was filled with loose soil and No. 2 with grass soil in natural condition.
* Weight of box No. 1. † Weight of box No. 2.

In this trial the loose soil lost .24 of a pound at night in 6 days, gaining on one night .03 of a pound, losing on 3 nights and not changing on 2 nights. The natural soil gained on 2 nights .11 pounds water and lost .23 pounds on 2 nights and 2 nights no change. It was a period of plenty of rain and heavy dews. In this trial the mere fact of gain or loss was sought without consideration of atmospheric conditions. It will be noted that loose soil affording free access of air lost on one night the most and gained less at night than the soil covered by grass. By the old dew theory, freedom of access of air is supposed to facilitate deposition of moisture. This probably bears upon the question of tillage, and so far seems to show that freedom of access of air facilitates evaporation of moisture, but it is by no means conclusive as one plat was covered by grass. As most of the water evaporated from a grass sod, passes through the leaves of the grass, it fairly raises the question, whether the water lost by the grass cylinders at night was not lost through the leaves of the plant.

The weighed boxes of earth were secured in their natural position by driving a cylinder in the ground and inserting a bottom by digging under. These lots of earth were left in their positions in the soil night and day when not being weighed.

SEASON OF 1885.

The night of June the 17th, the air temperature over the soil one inch was 69 degrees. In the morning of the 18th the air and soil were both 63 degrees. A box of earth taken in its natural position weighed 14 lbs. 13½ ozs. The next morning it weighed 14 lbs. 14 ozs. The air was cool and clear, and a good or heavy dew.

AT NEW HAMPSHIRE.

While visiting in New Hampshire I secured soil without grass on it in its natural position, in one box, the bottom of which was closed tight so that no water could rise from the soil beneath by capillary action. This box as all others have been was placed level with the soil and kept surrounded with earth. A second box was filled with loose earth, the purpose of which was to see whether tilling the soil effected the absorbtion of water as claimed from the air. Box 1 is natural soil, and box 2 loose soil.

	Air temp. on surface of the soil	Soil temperature on surface	Weight of natural soil.		Weight of loose soil.		Remarks.
			lbs.	oz.	lbs.	oz.	
P. M. August 2	67	68	30	7½	25	10½	
A. M. " 3	57	57	30	7½	25	9½	Night cold, little hazy.
P. M. " 5	67	69	32	....	26	1½	Rained the 3d.
A. M. " 6	55	59	31	14½	25	14½	
P. M. " 6	58	63	31	7	25	6	
A. M. " 7	55½	56	31	7	25	8	A little hazy—cloudy in upper air.
P. M. " 8	59	62	31	7	25	9	
A. M. " 9	60	61	31	11½	25	3	
P. M. " 9	58	62	30	11	25	½	
A. M. " 10	....	....	30	3½	24	13½	Air clear.
P. M. " 10	62	66	30	2	24	10½	
A. M. " 11	60	61	30	2	24	8½	
Total loss by day	....	....	1	5½	....	10	
" " " night	....	....	....	8½	1		
Total loss	....	....	1	14	1	10	

The solid or natural soil lost most by day and less than the loose soil by night. The results are singularily in accord with the view that stirring the soil retards the passage of moisture through it. Much less, or 46 per cent. less moisture was evaporated by day from the loose soil, occasionally stirred, than passed through the natural or compact soil. Again at night the compact soil lost when no gain or loss was made by the loose soil, while the loose soil lost most by day. Why is this? I can only account for it on the view that tillage breaks up the continuity of the capillary tubes of the soil and retards the upward flow of water by day when the soil is gaining heat and aiding evaporation. At night the loose soil in the surface when heat is escaping from the soil may reverse the action observed by day, although I must confess that the reasons are not quite clear to me nor do I feel sure that the fact is well proven. Doubtless an influence of tillage is revealed in these and following facts:

Four cylinders of earth 10 inches in diameter and 11 inches deep (in the clear) were taken just as they stood in the soil and a close fitting bottom was nicely fitted in the bottom of the cylinder of earth.

TRIAL OF 1885 AT COLUMBIA.

Date.	Wet blub temperature.	Air temperature.	Bare soil temperature.	Grass pipe temperature.	Pipe stirred 4 in. deep.		Pipe stirred 2 in. deep.		Unstirred pipe of soil.		Grass sod pipe of soil.		Remarks.
					lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.	
P. M., September 2	62	65	72	....	49	4½	52	1	54	14	.....	.....	
A. M., September 3	52	52	57	....	48	14	51	12½	54	12½	.....	.....	Rain after 3d.
P. M., September 9	51	58	67	71¼	53	1½	58	1½	56	14	58	9½	
A. M., September 10	....	52	54	....	52	10	57	11	56	11½	58	9½	
P. M., September 18	...	75	77	72½	50	4	54	8½	55	8	56	7	Pipes set out of ground in night.
A. M., September 19	....	58	55	51	49	15	54	2	55	4½	56	4	Clear night.
P. M., September 20	....	75	73	....	49	14	53	6	54	15½	55	3½	
A. M., September 21	....	60	65	....	49	10½	53	6	54	15	55	3	Heavy dew.
P. M., September 21	....	73	77	....	49	11	53	5	54	15	54	15	
A. M., September 22	....	63½	66	66	49	5	53	1	54	10	54	11	
P. M., September 22	....	64	66	64	49	7	53	½	54	11	54	8	
A. M., September 23	....	49	53	50	49	4	53	½	54	11	54	7	
Loss by night	....	....	....	....	1	15½	1	4½	....	13	....	8½	
Loss by day*	....	....	....	....	....	1½	....	13½	....	4	....	7½	

*Loss by day was so disturbed by rains as to be useless to consider.

Pipes one and two were occasionally stirred at the depth noted. The unstirred soil crusted over hard. The more I stirred the more it lost by night and probably less by day for a wet season, but for a dry season the reverse is true as seen in the next trial. Here again the more open the soil the more it loses at night. The loss by day is too imperfectly recorded in the above table to compare it with night loss, the weights too few to draw conclusions from. The night weights are good evidence and show clearly the influence of condition of soil on the relation of dew to soil moisture.

TRIAL OF 1886.

I used the same pipes of earth that were used in 1885, they having set in the ground during the winter. The trial began July the 16th. No rain had fallen during 19 days and ushered in the drouth that I desired in order to note the effect of dry soil and dry air on water absorbtion. In this trial we get the severest test of the question at issue, as capillary action is shut off in our pipes of earth from drawing water from below, and we may expect the soil to dry faster than the air and then, if ever, absorb moisture.

Not an inch of rain fell until the close of trial, August 10.

Date.	Air temperature—Degrees.....	Soil temperature—Degrees.....	Grass pipe temperature—Deg...	Deep tilled pipe weight..... lbs.	Deep tilled pipe weight..... oz.	Shallow tilled pipe weight. lbs.	Shallow tilled pipe weight. oz.	Pipe soil in natural state... lbs.	Pipe soil in natural state... oz.	Grass pipe..... lbs.	Grass pipe..... oz.	Remarks.
P. M., July 16.....	82	85	83	48	10¾	52	5¾	54	7½	50	7½	It will be seen that pipes had lost much in weight since 1885.
A. M., July 17.....	61	66	70	48	8	52	3	54	6½	50	2½	
P. M., July 17.....	78	83	....	48	7½	52	....	54	6	50	2¾	
A. M., July 18.....	71	71	....	48	7½	52	....	54	7½	49	14½	Dew light, indications of storm, but none came.
P. M., July 18.....	81	85	85	48	3½	51	14½	54	3½	49	14½	Little or no dew.
A. M., July 19.....	70	70	71	48	6	52	2	54	11¾	50	2⅜	Wind out.
P. M., July 20.....	....	....	....	47	15	51	11	54	....	49	14⅜	Little Dew.
A. M., July 21.....	68	71	71	47	16½	51	7½	53	13½	49	11½	
P. M., July 21.....	....	....	....	47	7⅜	51	7½	53	11¼	49	10⅝	Heavy dew.
A. M., July 22.....	61	61	61½	47	7⅜	51	6¾	53	11¼	49	10⅝	
P. M., July 22.....	....	....	....	47	7⅜	51	6¾	55	11	51	15	
A. M., July 23.....	70	69	70	47	10	51	9½	55	9	51	11½	Put some water into last—2 lbs. 3 oz.
P. M., July 23.....	....	....	....	47	6¾	51	7½	55	3	51	10⅛	
A. M., July 24.....	74	74	74	47	7	51	3¾	55	....	51	10¼	No. 2 had 3 oz. dirt spilled on it. No dew.

Date.	Air temperature.		Soil temperature.		Soil one inch temperature.		Grass pipe temperature.		Deep tilled pipe.		Shallow tilled pipe.		Natural soil.		Grass pipe.		Remarks.
									lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.	
P. M., July 24									47	5	51	3½	54	12½	52	....	Added 8 oz. water to grass pipe.
A. M., July 25	72	71							47	6¾	51	7¼	54	14	52	¼	No dew.
P. M., July 25	89	92					89		47	4	51	4	54	12	51	13¾	
A. M., July 26	73	74					75		47	4	51	4	54	12	54	2¼	Add 2 lbs. 6 oz. water to grass plat, moderate dew.
P. M., July 26	89	89					85		47	3	51	4	54	12	53	14¾	Mere sprinkle.
A. M., July 27	71	71					72		47	3	51	3½	54	10¾	53	12⅝	No dew.
P. M., July 27	82	91					91		47	2⅝	51	2⅝	54	10⅝	53	10⅝	
A. M., July 28	63	63	66	66			66		47	3¼	51	3¼	54	10⅝	53	11¼	Dew.
P. M., July 28	85	92					98		47	2¾	51	3	54	7¼	53	7¼	
A. M., July 29	69	69	72	72			72		47	2¾	51	3¾	54		55	4	Little dew.
P. M., July 29									46	15½	51	....	54	3½	53	2⅝	
A. M., July 30	76	76	77	77					46	15½	50	15½	54	3⅝	53	2¾	
P. M., July 30									47	7	51	7¼	54	7¼	53	6⅞	Rain, one-fifth inch.
A. M., July 31	69	69	71	71					47	4¼	51	3⅝	54	6⅞	53	7¼	Dew good.
P. M., July 31									47	2¼	51	2¾	54	6½	53	4	
A. M., August 1	71	71½							47	2⅝	51	2⅝	54	5	52	2¼	Sprinkled just after weighing. No dew.
P. M., August 1	89	90					90		47	2⅝	51	3	54	3 7/8	52	11 7/8	Sprinkled A. M.
A. M., August 2	66	66	68	68					46	15⅜	50	15¾	54	3¼	52	15¼	
P. M., August 2									46	15⅜	51	2⅛	54	2⅝	52	10⅛	No dew.
A. M., August 3	67	67	72	71					46	15⅛	50	15⅝	54	2 5/8	52	7¾	
P. M., August 7									47	2⅝	51	2⅜	53	14⅞	51	15⅞	A small rain.
A. M., August 8	62	63							46	14¼	50	15¼	53	15⅛	52	3	A fair dew.

Date.	Air temperature	Soil temperature	Temp. of soil one in. deep	Grass pipe temp	Deep tilled soil. Lbs.	Deep tilled soil. Oz.	Shallow tilled. Lbs.	Shallow tilled. Oz.	Natural soil. Lbs.	Natural soil. Oz.	Grass pipe. Lbs.	Grass pipe. Oz.	Remarks.
P. M. Aug. 8					46	12	50	$14\frac{3}{4}$	53	12	51	$14\frac{1}{2}$	
A. M. " 9	70	70	72	72	46	$11\frac{5}{16}$	50	$14\frac{9}{16}$	53	11	51	$11\frac{3}{32}$	Small dew.
P. M. " 9					46	$11\frac{1}{4}$	50	$11\frac{1}{4}$	53	$10\frac{3}{4}$	51	$7\frac{3}{4}$	
A. M. " 10					46	$11\frac{1}{2}$	50	$11\frac{1}{8}$	53	$10\frac{1}{4}$	51	$7\frac{3}{4}$	
Total loss in day time for 19 days						38		$30\frac{1}{16}$		44		44	
" gain for 5 nights								$17\frac{1}{4}$					
" loss for 12 nights								23					
" gain for 7 nights						$8\frac{3}{8}$							
" loss for 11 nights						$17\frac{7}{16}$				$20\frac{1}{2}$			
" loss for 11 nights										$11\frac{1}{2}$			
" gain for 6 nights													
" gain												$13\frac{1}{4}$	
" loss												$27\frac{1}{4}$	
Net loss—night and day						$47\frac{1}{16}$		42		$52\frac{1}{2}$		55	
" loss at night						$9\frac{7}{16}$		$11\frac{1}{4}$		$9\frac{3}{8}$		14	

REVIEW OF OBSERVATIONS.

1. I do not understand the law of these gains and losses.

2. I observe that soils lose by night, both when there is and when there is not a dew.

3. I note that the four pipes vary their losses and gains under different conditions of weather in unlike ratios, there being a loss in some pipes while there is a gain in others and that these relations are changeable.

4. That while the shallow tilled soil during the ordinary conditions of atmostphere that prevailed under the trials of last year lost less moisture by night than the deeper tilled soil, this year under a prolonged and severe drouth it loses most at night; also that when a gain is made it gains most at night.

5. The loss by night is often greater than the loss on the average day, indeed there is no loss on some days.

6. It should be explained that the grass plat was covered with blue grass, which withered when the drouth came on and stood on the ground more in the nature of a mulch than of a living plant evaporating moisture.

7. The water added to the soil covered by grass and to the pipe holding the unstirred soil increased for a night or two the amount of water evaporated.

8. A pair of laboratory balances holding about 1 lb. of earth, were balanced at night and while the soil contained fresh earth always followed the main pipe in tipping. But when moisture was well dried out of the earth then it gained moisture from the air at night. Now as this little amount of soil will cool much quicker to the air temperature than the earth will, it should gain moisture if any soil does. But it did not until practically exhausted of moisture.

9. The temperature of the soil was taken immediately on the surface of the ground and the air temperature was taken close to the soil. The lower earth was warmer and from this area moisture would be gathered to the upper soil. The gain of moisture from the air was on nights when the point of contact of soil and air were of like temperature, and it is probable that the surface soil gained moisture from above and below.

10. The tilled soil was always dry to the depth of tillage, and a pit a foot deep was dry to its bottom while in each case below the point stirred was a plain line of moist soil.

11. I cannot escape the conclusion that soil loses moisture by night as a general rule and doubtless during drouth the ratio of soil to air temperature is varied from its ordinary relation which modifies the relation of soil to dew formation at such periods.

12. The condition of the soil may be so modified by tillage as to effect the relation of dew to soil moisture, or more correctly affect the loss of moisture at night as well as by day. The method of tillage best to save moisture seems to be variable in times of drouth, and in ordinary times as between the gain or loss at night and during the day, but slightly favors shallow tillage. This of course does not consider the pernicious influence of cutting the roots of plants in drouth by deep tillage. This result with shallow tillage is in accord with suggestions in a previous Bulletin and will be again considered. As between tillage and no tillage we get the following balance, that

Shallow tilled soil lost per acre of 4,000,000 lbs soil.....	251,600 lbs water.
Deep " " " " " " " " " "	267,200 " "
Untilled " " " " " " " " " "	250,400 " "
Grass " " " " " " " " " "	270,050 " "

Allowing 400,000 lbs. of water per acre to be the normal amount of water for good crops, I find that the

Shallow tilled soil lost of total water in it.....	63.9 per cent.
Deep tilled " " " " " " "	66.8 " "
Untilled " " " " " " "	62.6 " "
Grass " " " " " " "	67.5 " "

The grass soil having for a greater part of the period no green grass upon it does not show the greater loss that would occur under ordinary conditions. The untilled soil was thoroughly crust hardened and perhaps would not give the results ordinarily to be expected. This result is seen in the trial at Gilmanton where the soil on the surface was not solid like that at Columbia.

A great deal is yet to be learned of this matter and others pertaining to the soil. While I have called attention to suggestive matter brought out in the dew trials, I wish it distinctly understood that

herein assert as conclusive only the fact that soils lose moisture at night. To ascertain this fact was the main purpose of the trial. The other matter suggested, I believe, warrants further inquiry.

Respectfully submitted,

J. W. SANBORN.

BULLETIN No. 24.

AGRICULTURAL COLLEGE,
COLUMBIA, Mo., Oct. 15, 1886.

S. S. LAWS, *President Agricultural College and University of Missouri:*

DEAR SIR:—I take pleasure in forwarding to you the following report of Dr. Paul Paquin, State Veterinary Inspector, covering his visit to France to pursue certain studies and matters suggested thereby.

Very respectfully,
J. W. SANBORN.

Prof. J. W. Sanborn, Dean Missouri Agricultural College:

DEAR SIR:—I have the honor to submit to you a complete report of my studies and labors in my official capacity during the past seven months. I should make a report every three months according to the law governing my position. You will remember that I accordingly did make one some time ago from Europe, but it was very short. Consequently, I recapitulate the whole matter here.

In the month of January last, the Honorable Board of Curators of the Missouri State University decided to send me abroad to study contagious diseases and their prevention by Pasteur's methods of vaccination and inoculation. It was intended that I should study contagious diseases of animals in Europe in relation to the same supposed to be in existence in America, including those transmissable from animals to man and *vice versa*. I will here explain what I have accomplished in that direction, and what, in my humble opinion, may be expected in this country.

On the last week of January I left Columbia for Europe, intending to stay in New York for awhile, and take certain special lessons to prepare myself for more difficult labors; unfortunately, I found it impossible there to get the instructions I desired. I had not enough time to

spare. The vessel upon which I was to sail was to depart soon, and besides the fees and other expenses would have been in excess of the value of the information I might have gained in so short a time. I would have sailed immediately on learning that, but I could not think of leaving without the promised document of the University, explaining my position and object, and asking for my admittance into the various institutions I desired to enter abroad. I wrote to the President of the University, and he advised me to cross and that the official document would reach me on the other side. So acting upon this advice, I boarded the steamer Weasland on the 13th of February and sailed to Antwerp, Belgium, where we landed after a thirteen days' trip. The sea was rather rough (it being in the winter as you know); a heavy fog and low tide kept us nearly thirty-six hours at anchor, thirty miles off Antwerp City. Finally I reached Paris on the last days of February. It was about two weeks later that I received the official letter of the University, endorsed by his excellency, the Governor of Missouri. The document appears to have been delayed a short time at this office. Thus you see, that from the moment I left to the date this reached me, considerable time was in a measure lost. It was totally unavoidable. I busied myself preparing the grounds theoretically. As soon as I got in Paris, however, I went to the United States Legation with a personal letter of Hon. James S. Rollins to Hon, J. McLane, United States Minister, who gave me an audience and favored my entrance into the laboratory of Mr. Pasteur, Rue d'Ulm. I could see then the inoculation performed on people for hydrophobia, and the operations performed on rabbits to procure the vaccine. I went there almost daily for a time from 10 to 12 A. M., and sometimes in the afternoon.

Regarding the studies I wanted to follow at Alfort in the School of Veterinary Science, I had to get first a permission from the French Minister of Agriculture. Hon McLane procured that for me also. I received it about the same time I received the University letter alluded to in the foregoing. It was only then that I was enabled to set seriously to practical work.

I at first divided my time as follows: In the forenoon I attended lectures on Histology, Pathology, Surgery, etc., at the Alfort Veterinary Medical Institution. They took place at first from six and later from five in the morning. From eight or nine to eleven, I attended the clinics at the hospitals. On Mondays I was busy all day from five A. M. to six P. M., in practical exercises of surgery—practicing, under experienced professors, the various operations of the profession. In the afternoon part of March and all of April and May, I pursued microscopical studies in

Paris, the two last months at the Charity Hospital in the Histological and Pathological Laboratory conducted by Dr. Latteux.

During my daily visits at Alfort, I spent considerable time at the laboratory of Professor Nocard—a co-laborer of Mr. Pasteur, and a man deeply informed on comparative medicine, principally in regard to contagious diseases. In June, through the influence of this professor, I was admitted into the Laboratory of Bacteriology of Cornil at Paris Medical School. This is by far the most complete laboratory of the kind in Paris, where foreigners, if they can gain admittance, may receive the most practical knowledge of the causation, nature and prevention of contagious diseases of man and beast, and the culture of germs. It is under the supervision of Dr. Cornil, of Cornil & Ranvier, renowned for their most able works in Histology and Pathology under the microscope. The director of the operations was Dr. Chantemesse, a former pupil of Koch of Germany, and at present assistant of Mr. Pasteur in the institute, bearing his name, on Rue Vauquelin, where inoculation against hydrophobia is now practiced.

I passed two months in that laboratory from one P. M. to six or seven. The work was mostly practical under the immediate supervision of Dr. Chantemesse, or his assistants.

In the month of June I neglected the Alfort clinics certain days in the forenoon in order to visit the laboratory of Mr. Pasteur, especially Wednesdays, when Dr. Perdrix, one of his assistantants (former student of Koch also), gave two hours' lectures, theoretically and practically, to foreigners and others who were fortunate enough to be admitted. These were the only special instructions given in the celebrated man's place. Of course the Pasteur discoveries, his methods of cultivating germs, the attenuation of virus, etc., were fully explained and practically demonstrated, but nobody was permitted to assist in the preparation of the vaccines which he, Pasteur, furnishes to the country to prevent the various diseases against which his methods succeed. He or his assistants make no secret of what they know and do, or how they do it, but they wisely do everything themselves and by themselves, so that no error may occur to compromise their reputations,—the reputation of their theories and their success. The operations are so delicate and require so much cleanliness and care in order to get pure vaccine that they do not want to run any risk.

I have the pleasure to say, however, that I had the good fortune to learn what I expected to. I trust it is as much as the University expected of me also. Naturally, I do not wish to impress on your mind that I possess perfectly the subjects I studied. The time at my disposition was rather short to learn thoroughly such difficult matters,

but I believe I can now continue my labors and conduct them to a good end with benefits to those concerned.

Financially speaking, I was taken unawares. My studies have cost much more than I expected. The instruments, loboratory fees, tuition, etc., came to quite a sum. I will never regret the excess of my expenses, however, if I can be of real usefulness to the State and University by the new information which I have gathered. In this I hope that by truly conscientious and constant endeavors I shall succeed.

CONTAGIOUS DISEASES.

Let us be plain. What is a contagious disease? It is one that can be transmitted from one subject to another of the same or different species. How is it transmitted? By different means. It may be through the air which carries the *virus*—the contagious matter from a diseased case to a healthy one, when it may be inhaled in breathing, ex.: Contagious pleuro pneumonia; it may be through the water or food; in the home and field for man, in the field and stable for beasts, where for some it may be also inhaled and others ingested, ex.: Diphtheria, glanders, Texas fever, etc., or it may be accidentally or artificially by direct *inoculation*, an apparently insignificant operation, which, however, transmits the mighty and dreadful *germs* of the maladies. I say *germs*. It is the very point which I shall endeavor to elucidate first, at the risk of being accused of repeating what has been written and spoken a thousand times; for, notwithstanding this fact, the assertion that germs are the cause of certain diseases, still sounds like a myth to the ears of those who are strangers to the wonderful discovery.

Did you ever stop and think how it is that an almost, if not totally invisible quantity of *virus*, from a subject having a contagious disease, can cause the same to reproduce itself with the same symptoms in another? Take smallpox in man for instance. Dip the point of a needle in one of the thousand pustules that make such a fearful sight of his body. You may not see the particle of matter left on the light instrument, and yet if you thrust it slightly into the skin of a person not having been vaccinated, that person will become affected with the horrible affliction. Does not that seem most wonderful.

Take another disease—one among lower animals (for man is but a reasonable animal—it is false delicacy to deny it). Take anthrax or charbon, which, when transmitted to man, causes the deadly malignant pustule. How does this occur? A little scratch, the least raw sore on the surface of the skin may allow a minute portion of virus of

infected hides or residues to be absorbed and the disease takes its course. Such cases frequently occur to tanners in countries where this affection exists. It is asserted that even flies transfer the deadly poison of the malady.

Let us consider still another one—chicken cholera—the true chicken cholera which depopulates our barnyards with such formidable rapidity. It suffices to dip a pin in the blood of a deceased bird and prick a healthy one to see it die shortly with the same affection. Then if you repeat the operation with the blood of this last bird on another healthy one, you obtain the same results, and so on if you continue the operation. So many inoculations, so many deaths as a rule. The same thing may be said with as much veracity of glanders, septicæmia (blood poisoning), etc.

Now if you examine with the microscope (strong power, and you must know how to use it); if you examine, I say, the tissues of certain parts of some of the organs (constituting the body) of subjects affected by glanders, charbon, hog cholera, chicken cholera, septicæmia, etc., you will find them to contain certain germs by the millions and billions—germs which you *do not* find in healthy subjects. But if you inoculate the most minute particle of such tissue or matter to an inoculable healthy subject, you will find the same germs reproduce themselves: some very rapidly, others more slowly. Some say those germs are the *result or effect* of the disease and *not the cause.* In reply, I say give an example of a living thing that grew spontaneously without father or mother? No, the spontaneous generation theory or doctrine to which Aristotle, Virgil, Van Helmont, Redi, Buffon, Needham, and later, Mr. Pouchet, director of Museum of Natural History of Rouen, gave the authority of their names, was annihilated by the discoveries of Pasteur. His revelations at the Academy of Science fell like a shell on the fragile edifice, and crushed its columns into atoms. See dicision of Commissions of the Academy of Science, June 15, 1864.

But you may say, it is not possible that the germs are dormant in the body, and that they develop themselves only when certain diseases occur—diseases which, by their alteration of the system, produce a favorable soil for their growth? Perhaps, in fact, certain kinds of germs are dormant in some organs, as they are in the ground, or as wheat in a bin. But that does not say that they have grown there spontaneously. The following proves that such and such a germ gives rise to such and such disease only: If you look for the germs of chicken cholera in a healthy bird you cannot find any, not even in a dormant state; but if you take some virus of this disease, isolate, *i. e.*, separate the germs as is done in the laboratory, inoculate a chicken

with some of them pure, free from any other substance, you will produce the very same malady. If you look in the newly inoculated subject soon after the operation, you will find them innumerable, and yet not so numerous as later on; they have only partially invaded the soil, for, although they grow and pollute with inconceivable rapidity, they are excessively small; they did not, therefore, have quite enough time to multiply themselves sufficiently to furnish emigrants and send them to the various countries of their new world; a little later, however, you will find myriads of them in many parts of the body. In substance, the same order of things may be produced with a great number of contagious diseases known, including *tuberculosis* (*consumption*). And it can be done as well with pure, separate germs taken from diseased subjects and cultivated in suitable soil for years *outside* the animal body. This is done by certain laboratory methods—a point which we will discuss further on. What power can accomplish things of such nature? There is but one on earth; there is but one power that can extract the immeasurable from a unity—it is the inexplicable, admirable, strange, mightiness of life! Its marvelous laws only can explain to our senses the reproduction of these germs—reproduction which is simply astonishing in comparison with visible ones, be they ever so small. They are living organisms, happily termed by Pasteur, "the infinitely small" of a world invisible to the naked eye.

Can we believe such statements? I reply by another question. Can we deny the existence of things which we can see, touch, move, reproduce? What we term contagious disease, then, probably in all cases, is only the expression of, the perceptible signs of the growth of germs in the body, and it is the alteration of the system due to that vegetation that causes sickness and death. We are naturally perplexed at the wondrously quick development and increase of those little organisms. Well, it is not comparatively the same in living things that we can see and appreciate? Look at the enormous maple tree in your lawn, and consider the slimness of the green grass carpeting the ground, shaded by its heavy foliage. Both belong to the vegetable kingdom, both are nature, both are healthy, and yet what a contrast! But it has taken years, perhaps a century to make that majestic tree what it is—in a few months the grass has grown and perhaps multiplied itself. Sow seeds of different vegetables side by side and you will realize the striking difference in vegetation.

The same things may be said of animals. Small ones generate their like much quicker than larger ones. The potato bug (*doryphora*), to illustrate a common one, may give rise to three generations a year—each female laying an average of 600 eggs, which hatch in less than a week. Now think of the difference in generation with the horse.

Both belong to the animal kingdom. Well, the same law seems to exercise its its power over the smallest living subjects of the world; those that we cannot detect without powerful optics and means to stain them and show their conformation and size. These little ones are usually called *micro-organisms*, or microbes (derived from the Greek *mikros*, little, and *bios*, living), where we speak of them in a general manner; but when they are referred to as causation of disease, they are often termed simply bacteria, or germs, the title I have given them here. In some of them, seeds or eggs have been discovered. For instance, in anthrax fever, the bacteria that causes it shows brilliant spores or seeds that detatch themselves, and may be preserved years in a dormant state and then grow in the animal body if they get access to it, just as oats may be kept a long time and afterwards sown with good results. They probably belong to the vegetable kingdom. Experiments point almost conclusively towards the confirmation of this belief. In fact it is certain that some do. Like plants, too, they grow quicker, larger and healthier in soils rich and better suited to their formation. In contagious diseases the body is the land in which pernicious microbes are sown, and among the various organs of the general system some prove better soil for some kinds of germs than others, just as certain patches of ground on a farm are better suited for some kinds of grains than others. It is thus that we find tuberculosis (consumption), glanders, contagious pleuro-pneumonia, developed principally in the respiratory organs, Texas fever in the spleen, small pox in the skin, hydrophobia (rabies) in the bulb and spinal cord.

I have alluded to the cultivation of disease-germs outside the animal body. I will explain this point more fully, and hope to convince the most skeptical.

Mr. Pasteur in his researches discovered that one could prepare as good, and even better soils in the laboratory, for the cultivation of microbes than are found in the animal system. Among the many suitable ones we have chicken broth, veal and beef gelatinized broths, blood serum, potatoes, milk, etc., etc. These media just take the place of the body. In them we sow the germs pure, separated from all other matter, and they grow like they would in the system of the animal. We can reap one crop and sow an invisible particle of it in another artificial medium and it will grow there also. We may thus get crop after crop to a thousand and more generations and still they will preserve their powers of reproduction. Then, if we take a microscopic particle of the last generation and inoculate it to animals naturally apt to contract the affection which furnished the first germs for these cultures, they will get it and probably die from it. This question has been proved beyond refutation. I would not hesitate to

repeat the experiment if it were necessary to sustain my assertions. Science has brought the cultivation of microscopic living things to a practical business. We can see them grow like a plant in a flower pot.

Do you wish to test the subject of cultivation of germs and contagion yourself? Here is a way if you are adapted to the business of making experiments. We know that vinegar is due to the vegetation of a microscopic plant named *mycoderma aceti*. It is a minute vegetable cell which is so amazingly prolific that in a few hours millions cover like a velvety scum, the surface of any liquid becoming vinegar. To obtain this germ it suffices us to take a little claret wine and expose it to the air at a warm temperature; soon we see on its surface some little specks and later larger ones like a film. Now take a tub, say about three feet of surface, put a liquid into it proper to the nourishment of this microbe: water with some alcohol, a little vinegar and phosphated alkaline salts will do, put an impreceptible particle of such specks or scum and touch the surface of this mixture. In twenty-four hours or about, the whole surface. will be covered by a uniform thin veil formed by an infinite multitude of vegetable cells. One cannot appreciate them separately without a microscope. Experimentalists of repute have assured us that every thousandth square part of the surface of such a liquid sometimes contains as many as three hundred thousand cells, making three hundred million for the whole surface. How prodigious is that strength of life! Now if you have another basin of such a liquid, and a particle of that scum falls or is purposely deposited upon it, the same growth will take place. The operation may be repeated with the same result infinitely. These are a kind of culture. That is exactly what occurs in contagious diseases. What we can see so plainly in the tub is the phenomenon which produces itself in the body of animals. In the tub during the generation, the growth of the germs causes a chemical change to take place and thus produce vinegar; in the body they produce certain poisoning principles —*ptomaines*, etc., which, with the mechanical action of the germs, causes disorders, illness and death.

But, if like ordinary plants, the microbes grow in proper soils, like them also they stop growing when the substance proper for their formation, is exhausted. In fact, if we cultivate the germs of a disease in a certain and the same soil, a broth for instance, they will grow for a time and then stop, for they find no longer the elements necessary for their nourishment. Yet they may still live for a certain length of time. Splenic fever germs, for instance, stop growing when they have exhausted the material proper for their formation, but they are not dead; they indeed give seed as I have said before. Those seeds or spores are visible with the microscope; like those of plants to which I

have compared the micro-organisms so often, they may live in a dormant state for years perhaps, and then grow if they find a suitable medium. Such is the case when charbon develops itself suddenly in a pasture in a community where the disease does not exist. The germs may have been deposited there years before; a carcass may have been buried there and the germs brought to the surface of the ground by earth worms. Pasteur gave us irrefutable examples of that sort. The germs of Texas fever seem to be deposited that way over certain lands.

When the soil of media sown with germs of a certain affection is exhausted, they become weaker and weaker, and when inoculated to animals in very weakened state they do not give as severe a disease as before. Fewer animals die from the effects. The germs having degenerated seem to transmit their weakened condition or constitution to their offspring; these grow with less rapidity and are less prolific it seems, for they cause a much milder form of disease: such is the case in splenic fever, chicken cholera, etc. There is another opinion regarding the direct cause of a milder affection in similar circumstances, but this seems to be the prevailing one; for although this heredity question is incomprehensible in its principle, its operations and results are conceivable, because we have examples of them in the visible world. I remember well a fine large apple tree in the great orchard that surrounded the house of my father. It was the boys' and girls' favorite when I was a child because it bore large, red, sweet juicy apples that ripened early—and besides it was forbidden fruit. The tree at the time was getting old, however, and every year we noticed with great sorrow that it was gradually losing its vigor and that its fruits declined in size and number. They tried hard to preserve our good old friend in strength, but they knew not how. It was not dying fast; it was slowly getting weaker and weaker. This degeneration kept going on until the apples ripened before they had attained the size of a hen's egg, whilst they used to grow as large as a good sized cup.

One day seeds from those fruits were sown in a special spot, in the garden, and soon little trees appeared. Two or three years later they were transplanted into the large orchard, in the best soil. There we watched and waited anxiously for the first apple. We expected, of course, the large rosy-cheeked one of the big tree of our younger days—tree which still existed, however, at this time, but bore shriveled fruits smaller and smaller. Indeed, I fear we were ungrateful enough to scoff at the dignified octogenarian when we beheld with admiration the first blossoms adorning the head of its young offspring. They surely would be "the goodliest trees laden with fairy fruits." How large and nice, and juicy those fruits would be! The very thought brought water to many mouths. At last they showed their little faces; although

we thought them rather slow in growing and then in ripening, we did not care so very much. We simply let them alone for a time, and then, behold! a little bit of an apple, not larger than a dried butternut. We called it a clear case of swindling on the part of *Dame Nature*, but she had but obeyed certain laws of heredity in life. It was a transmission of degeneration from parent to offspring in the vegetable world. It is about what occurs in the weakened microscopic degenerated germs which we sow purposely in an artificial preparation, or in the animal body. Their proliferation is much diminished, and hence, as we can readily understand, the effects of their vegetation are much milder. Struck by this phenomenon and knowing that certain contagious maladies occur but once in a long time in the same subject, Mr. Pasteur endeavored, intentionally, to weaken still more, their virulent germs. And, behold, the beautiful result! He succeeded in attenuating them to such a point that they still cause a slight derangement of the system, but not severe enough to kill, and yet sufficiently powerful to confer immunity, like vaccine against smallpox in man. In other words, he weakened, artificially, the *deadly virus*, and made of it a benign one—a *vaccine*. Now, how does this vaccine confer what is called immunity; or, in other words, render a subject proof against a subsequent attack of the malady it is intended to prevent? Is it also due to exhaustion (for a time) of certain materials of the body which are essential to the rapid and numerous development of germs? Or, does any chemical change, unfavorable to the life of these microbes, take place in the system? The former hypothesis seems accepted by many, yet, neither of them is a satisfactory explanation to the mind. It is a very important point to enlighten. The most important one, however, is the result obtained by introduction of weakened virus into the body of healthy animals—protection from contagious plagues. This brings us to vaccination.

VACCINATION—(inoculation).

All forms of preventative vaccination are explained by the discoveries of Pasteur. Even vaccination for smallpox although discovered long ago by the immortal Jenner, is explained by Pasteur's theories; indeed, scientists have established that vaccine against this dreadful affliction is the virus of *horse-pox* attenuated by its passage through the bovine species (calves).

As to the substances used as vaccine for other affections, I need not repeat here their general mode of production. This has already been explained in the foregoing remarks, where we alluded to the attenuation of virus by certain methods of culture, and in this condition

their introduction into the body to protect against contagion. Other details necessary will be developed as we proceed.

The matter introduced into the body, as preventatives, is not always weakened virus. Indeed, there are certain very serious maladies whose virus it has been, so far, impossible to mitigate with any good result. And yet, we inoculate the same virus with good success against the very disease they cause. Such is the case in contagious pneumonia and sheep-pox. We will see further how in such instances the supposed immunity is conferred. By the way, it may be well to remark here, that I have used the words vaccination and inoculation indiscriminately for the operation which consists in the transmission of the agent of contagion from a subject to another, but as a rule—although it has, perhaps, no great practical value—*inoculation* is meant for the artificial transmission of *non-attenuated virus*, whilst vaccination means the introduction into the body of *attenuated virus*—or vaccine. The affections against which attenuated virus is used as preventative are: Small pox, hydrophobia (rabies), chicken cholera, French swine plague, blackleg, essential charbon, or anthrax (a splenic fever resembling somewhat Texas fever). So far, those inoculations, except smallpox, have been resorted to, I think, only in France, Germany and Switzerland.

The actual transformation of virus into vaccine is arrived at on the principles already described, but by various manipulations; for some it is by means of culture with the aid of proper instruments in the laboratory, and others it is by transmitting the disease to animals of different nature, which prove poor soil, thereby mitigating the virulent agent. The vaccine of hog cholera, for instance, is obtained by transmitting the affection to rabbits, and for smallpox it is more than probably nothing else than horse pox attenuated through the system of cattle, as I have said. We may use vaccine directly from the horse, but it is much more powerful than after having passed through cattle. Whenever horse-pox breaks out in France now, they simply inoculate calves, and keep inoculating them for the production of vaccine for the public. So they do in other places in Europe.

Let us consider briefly the diseases which concern us more directly.

HOG CHOLERA.

I need not describe here the symptoms of this affection. In Europe it is assumed by scientists that the hog cholera of America is the same as what is termed *Rouget du Porc* in France, and American writers who have studied the matter on this continent believe they differ, and

they seem to be in the right. Both opinions are entitled to respect and worthy of consideration. Perhaps more than one kind exist. This is a point, therefore, that needs elucidation. I would not venture a personal opinion on the subject, because before going to Europe I had not had the advantage of studying microscopically the American hog cholera, and I have just arrived home and have no laboratory sufficiently equipped for such a study now, and, besides, I would not venture an opinion so soon. Whether they are exactly the same or not, one thing is certain, we know that both are due to germs; that they resemble each other physically and pathologically—at least to the naked eye, and that the one in Europe is prevented by vaccination. The great object to attain is the production of an efficacious vaccine in this country. The chief of the Bureau of Animal Industry, Dr. Salmon, has and is still devoting much time and making careful researches in that direction. I had the pleasure to read, not long ago, that he had made some very important discoveries which were calculated to give us the desired results. We must assist him in his labors if we can, and this without producing confusion. Conscientious, disinterested, scientific researches may benefit his work and the country, but talk and criticism not based on such a foundation are apt to make the matter only more difficult and obscure. If differences of opinion exist in the minds of competent workers, it might be better to let them follow their own path towards a common end. Nothing more reasonable, nothing more rational than to expect to attenuate a virus of our hog plague on the same principle that it is done with the French hog plague, and get as effective a preventive. Unfortunately, outside of the Bureau of Animal Industry, I know of no institution where such pursuits can be followed. As for us at our University, we have not the means. We have not the funds to equip a laboratory, and we cannot accomplish anything in the way of experiments without that. Yet we are bound to contribute our mite to remedy this terrible scourge if possible. If we can get no financial aid, we will creep and will endeavor with our little knowlege to benefit our stock raisers whether they will or not. The stock raisers! the agriculturists!—are they not the first to be benefited by any means that may protect their animal wealth? Why, then, should they not assist, financially, those who spare no sacrifice to get to the very root of that most destructive affection, hog cholera, to speak of no other? I have no doubt that some would cheerfully do so on the strength of hope alone, but on the other hand, how many would exact a strict guarantee—a pledge that within a year we must prevent all the hogs of Missouri from getting

sick? That is the sentiment that governs too many of those who are in a position to benefit the country greatly while benefiting themselves.

I have now before my eyes a report of a French veterinarian's vaccination against hog cholera (Rouget) in Lorraine. He vaccinated two hundred and eighty-three hogs with Pasteur's vaccine. Three of them only died of the disease after vaccination. At the side, or with those hogs, he had left seventy-three non-vaccinated ones to testify as to the efficacy of the treatment. The result was that the whole seventy-three died and the two hundred and eighty others remained healthy. Is not that a beautiful success? Still, this vaccine is not as true and as safe a preventive, as yet, as vaccine of smallpox is in man. Certain breeds of animals resist the vaccine of the disease better than others, and vaccination is much more successful in young subjects. Those are difficulties which even in Europe must be overcome by constant and intelligent experiments. They are barriers which may interfere longer than any other, perhaps, with the general success of the prophylaxis. The production of an attenuated virus, even though we may have to invent an entirely new one, may not, perhaps, present greater difficulties to conquer. It is to clear all those obstructions that help is needed—funds for animals, buildings, laboratory, instruments, etc. But do not exact such a result in a year or so. The country may possibly be somewhat rewarded for its labors within that time, but it can hardly be expected, for it takes all of that to conduct certain experiments to any practical result. What is a year of labor for such a mighty task? Give us proper time.

It has taken a great many years for Pasteur to accomplish what he has in contagious diseases. But he has done the hardest part of the work, and we have but to follow in his track. The difficult part now is to experiment successfully. Are we then going to remain indifferent when we lose millions of dollars annually through a single disease, saying nothing of several others which, we may confidently hope, will be prevented in the future by the same methods? I hope not. To you who are personally interested in the subject, I earnestly appeal to your sense of personal benefit and feeling of generosity. Help us and we promise our energy and life to your service.

TEXAS FEVER.

It is useless to describe this well known fatal malady, either. It seems to be, to a certain extent, of the nature of the essential anthrax or charbon, in Europe. The kind of organs principally affected, their appearance and the germ origin, suggest that idea. The two diseases

act differently, however, in their mode of transmission, and consequently they are different. It is another affection against which diligent studies may lead to the discovery of a preventive in the future. Charbon, in France, is vaccinated against very successfully.

BLACK LEG (SYMPTOMATIC ANTHRAX).

This disease, so common in this country, can be successfully prevented now by Cornevin & Thomas' method of vaccination, founded on the principle of microbes as a cause of the disease. But this method, which consists in inoculating the vaccine directly into the blood vessels, is not, as yet, practical enough to be adopted in a general way. It may be considered in its infancy, and, no doubt, will soon be improved. The important point to observe is that this vaccination produces immunity against black leg, and that hence we may expect a practical process of operation ere long, even in America, if our black leg should prove the same as that of Europe.

CONTAGIOUS PLEURO-PNEUMONIA.

I have already been severely criticised for advising inoculation against this affection in this country. Dr. Salmon, the hard-working and scientific head of the Bureau of Animal Industry, is of the opinion that it should not be practiced in such a great stock raising country as America. The chief of the bureau has had much experience with the disease in question in this country. This fact, combined with his official position, places him in a condition in which he can judge very accurately from every point of view what would be the result of this treatment among stock on this continent. However, I uphold, on a scientific basis, that inoculation for contagious pleuro pneumonia is rational, and could be practiced, in certain conditions, with as much success here as in France, where it is enforced by law and effectively applied, notwithstanding what may be said to the contrary. I have seen its effects.

Perhaps I will be again personally attacked for this declaration, and perhaps, also, my utterances may again be alluded to as based on enthusiasm. Well, just as the soldier on the battlefield must do his duty and face the fire, unmindful of the bullets of his enemies, so must we on the field of science boldly assert what we believe to be truth, and never falter in fear of being wounded. I have studied my subject and reflected on the bearing of my principles, and believing them right, nothing shall prevent me from defending them, as I am called upon to do, until convinced I am wrong by logical discussion and facts, and not emrely because a voice, or many voices, would bitterly criticise in a

forbidding, authoritative tone. I respect and love authority in its principle, but duty and justice above all. Would I dare preach a doctrine injurious to the country? Far from my heart such a sentiment. I seek for benefits through truth, which alone can stand, and we can find truth on scientific problems only by peaceful, unprejudiced, impartial, impersonal and fearless discussions, based on experimental observations and studies.

I think, however, that Dr. Salmon, in his report for 1885, does not really dispute the efficacy of the treatment when performed strictly in accordance with the most recent discoveries of science. Some of his publications or criticisms since are what may lead us to such a belief. But, undoubtedly, he had some good reasons for his utterances. What are the results of inoculation against pleuro-pneumonia? A very small percentage have traumatic gangrene of the tail, sometimes passing to septicæmia (blood poisoning), and then death. Statistics place the number of such cases, without death, in France, in the last years, at two or three, and it is believed that some of these are not cases of gangrene of a septic nature, but are simply due to the inflammation which sometimes arises to a considerable extent at the point of inoculation, although no septic germs are inoculated. This may be true or may not, but in neither case, however, does it constitute a bad card against vaccination, because it is hardly more serious than accidents which can be expected in many other surgical operations of such nature and which we do not hesitate to practice. And, besides, most of those cases of gangrene, whether septic or not, may be remedied if attended to properly before general disorder or blood poisoning has begun. It suffices to cut the tail off, or if it is early enough, in septic gangrene, good results may be obtained by scarifying the tail all around and above the swollen portion, and rub in tincture of iodine two or three times a day. It will be absorbed and will limit the progress of the disease, probably by killing the germs. Of course, such troubles and their consequences are a financial loss. Undoubtedly a sick animal loses some of its value during illness, particularly if the result be the loss of the tail, or a portion of it. But it is better to have a cow without a tail, than to have the tail without the cow. Indeed, this ornament and the hide are, perhaps, about all that may be reasonably expected from cattle in a diseased herd, or exposed to one affected with contagious pleuro-pneumonia. Hence, with such a light percentage of accidents as I have stated, and the treatments which may be instituted to combat them, does it not seem reasonable to inoculate? But some countries give us a much higher percentage of accidents and death by septicæmia than that. [See statistics of the Bureau of Animal Industry.] Why is it? How is it that we have septic engorgements or

swellings of the inoculated part? It is due to the introduction of septic germs into the wound made in inoculating, or in the unprotected, and perhaps, sometimes abraded and inflamed tissue after the operation. We can find those germs there, and find also the septic poison they engender in their growth. Where do these micro-organisms come from? Either from the vaccine inoculated, or from the surrounding air. Let none of those innumerable, infectious microscopic living things penetrate into the tissues, and there will be no kind of true septicæmia. The most favorable soil for the development and multiplication of those polluting microbes is what is called the conjunctive tissue, a loose substance which exists in abundance under the skin.

Now, could we prevent the occurrence of such accidents? Perhaps we could not always do so in the extremely rare cases of gangrene due to the stopping of circulation caused by the work of inflammation, but in ninety-nine cases of one hundred we could, it seems, prevent septic poisoning from occurring or limit its progress (by the means already described). To arrive at that, we must first inoculate matter containing none of the infectious microbes; second, we must place the vaccinated beasts in such a condition that none ever get access to the tissues involved by the treatment. But are not the lungs from which we generally take the virus to inoculate with, full of germs breathed in with the air? Is not the atmosphere more or less full of them everywhere? True, and here is the great point. Here lies one of the secrets of the disappointments which have so often served as a basis of the false opinions expressed regarding vaccination for the malady in question. If your humble correspondent and servant dared to give an advice, he would say: Choose a beast affected with contagious pleuro-pneumonia in the first stages; take the virus from the pleural cavity and inoculate immediately those to be protected, the whole operation being performed with thoroughly disinfected instruments. The pleural sac being closed to the external atmosphere, it is rational to hold that its liquid can not contain any external germs during life and immediately after death. If no other subject could be had to take the virus from, than one dead since a certain time, it would be better, I think, not to vaccinate at all, unless it be urgent to protect part of a herd supposed to be already infected, and that the vaccine be gathered only a few hours after death. Then I should insist still more on taking the virus in the pleura and using strictly anti-septic methods. Carrying vaccine virus from one place to another should be avoided as much as possible. But if it must be done, let it be in proper glass tubes, having been sterilized, i. e., disinfected by a high temperature, say one hundred and fifty degrees centigrade, using every precaution possible in handling. None

but careful professional men could accomplish these recommendations strictly.

Some reliable operators, however, use with success the light colored liquid which exudates from little cavities purposely made in portions of diseased lungs in the first stages. It is certainly effective, but it is difficult to know whether it is pure or not. Owing to the fact that conjunctive tissue is a very favorable soil for septic germs, it is preferable to vaccinate superficially in the tissue of the skin—the derma; endeavoring at the same time to avoid bleeding as much as possible, for with the blood the virus may go off and no absorption take place. The point for inoculation is about the tip of the tail on the lower surface, after it has been washed thoroughly with a solution of corrosive sublimate or carbolic acid, and then wiped entirely dry with a clean cloth. Immediately after the insertion of the vaccine in the derma (some say under the skin, which would not be more dangerous if the vaccine be pure), I think it would be a good plan to cover the puncture or scarification with a little collodion and castor oil. This forms a thick scum which would protect from foreign germs. Either a syringe or lancet is used to perforate or incise the skin. If the former instrument be used, it should be thoroughly disinfected with a solution of corrosive sublimate, or sulphuric acid, and then washed in clean water; if the latter be used, it may be sterilized by passing it in the blaze of an alcohol lamp. All this can be done quickly and accurately by a skilful operator and an intelligent assistant, much more so than I could possibly describe it in the shortest intelligible terms.

Is there anything like such precaution taken by the average operator? Some indeed are very strict, but far too many inoculate without any anti-septic methods whatever, using virus from any portion of the lungs even long after death and then insert that virus into the tissues without any discrimination; hence they often sow in their most favorable soils, the septic germs of blood poisoning. Is it a wonder, then, that such accidents occur? Dr. Salmon is right in discouraging inocculation in this country, if he bases himself on the belief that the imperfect manner in which it is practiced cannot be remedied soon enough to render it safe and practical. It is this reason which has induced certain countries to reject it, whilst others more advanced in science, and better supplied with scientific operators, have made it a law. And I presume it is partly for this reason that the Bureau of Animal Industry forbids it.

Another point urged against vaccination is that subjects may become affected with pleuro-pneumonia afterwards, and die; or that, on the other hand, inoculation may cause the disease itself and spread it. Now as to the first objection, we might as well put it in the way of

vaccination against smallpox in man, for he also occasionally gets smallpox after having been vaccinated. The majority of such occurrences, I venture to say, are due to avoidable errors—bleeding, weak virus, etc., and certain other circumstances which defeat both objections. Let us explain them. Contagious pleuro-pneumonia is a most insidious disease. This fact is settled and well known. Hence, when inoculation is practiced among apparently healthy animals in an infected heard, it frequently occurs that subjects already diseased to a serious extent, and not having any perceptible signs, undergo the treatment. These are the the cases which may get sick after inoculation, and whose death, if it occurs, we wrongly attribute to either the inefficacy or the very effect of that operation. Indeed, there is nothing more consequent than such a result in a similar circumstance. If a cow already has serious lesions of pleuro-pneumonia progressing in the respiratory organs we need not expect to cure her by starting the disease, however mild, in the other end—in the tail. It would be in this case like trying to stop a big fire already raging on one side of a building, by setting a little one on the other.

And it is just in such occurrences that subjects die, and the disease spreads after inoculation. We can readily understand that. The affection was in existence, and too far advanced, before the vaccinator tried to protect the animal, and it continued its course as usual, if, indeed it was not hastened by his deed, as some authors believe it may. At this point I respectfully make a few remarks respecting the regulations that the honorable Commissioner of Agriculture in reference to the eradication of contagious pleuro-pneumonia according to the new act of congress. Articles or clauses, thirteen and fourteen, give State authorities permission to inoculate "cattle in herds in which pleuro pneumonia has appeared only." Now in accordance with the opinions herein explained, I would scarcely attempt to perform the operation under such restrictions, for it would be at the risk of falling, with the worst effects, into the errors pointed out. In a word, I would not consent to inoculate against contagious pleuro-pneumonia without having good reasons to believe it had not attacked the subjects, or else I would have a thorough understanding as to the results, for the deaths which might take place afterwards in such circumstances would be charged to the operation, as already stated, and it would but add strength to the wrong views held in this regard. It is on such principles that in an article to *Coleman's Rural World*, while abroad, I advocated the inocculation of non-affected animals—cattle which had only been exposed in order to limit any center of infection making its appearance in a rural community, and these are the doctrines which

were so severely condemned by the Bureau of Animal Industry. But now the regulations of the Department of Agriculture prevent any reliable investigations to be followed on the subject of inoculation, and I presume this question must be set aside. We will applaud to the restriction, however, if we can with the aid of the new law, stamp out forever the troublesome affection. I wish it earnestly. And like Dr. Salmon, I believe that there is no better means of eradicating the malady under discussion, than by killing all the affected herds, if it can be done. I never had any desire to oppose such a practice, or deny this truth by any means, but that does not exclude inoculation from the highest rank among the scientific prophylactic (preventative) treatments.

Now, I may be asked how is immunity conferred, or how are animals protected against contagious pleuro pneumonia without giving the disease strongly by the inoculation of pure non-attenuated virus? Well, it is probably the result of the application of one law which I have spoken of elsewhere in this writing. Certain soils in the body are better suited to the growth of certain germs, just as the same thing is true in the culture of seeds on a farm. The virus of pleuro-pneumonia grows slowly and poorly in the tail, probably because it is a soil which does not contain the elements proper to its rapid development, and consequently it is attenuated and causes a comparatively mild trouble, which insures against a second attack. This seems to be the accepted theory among a number of scientists, but of course it cannot be relied upon as a positive fact. A curious thing exists in regard to the effect of artificial inoculation of certain contagious diseases, in comparison with the effects of the same when they have accidentally taken hold of the subject or subjects. The disease given purposely by inoculation is much milder than that caught accidentally one way or the other. Smallpox in man and contagious pleuro-pneumonia are types of such maladies.

SMALLPOX.

Before my departure for Europe, as you are aware, the honorable Board of Curators of the State University established, on the recommendation of Dr. S. S. Laws, the President of the University, and the medical faculty, a vacine and experimental laboratory, and I had the honor to be appointed to the direction of its operations and services.

The responsibility of this position is very heavy considering the thousands of human beings whom, to save themselves from a horrible disease, are forced to submit to the inoculation into their body of a substance of which they know nothing—not even its source, which is

of capital importance. Indeed, this is the point which necessitates the greatest prudence, and a certain knowledge of the contagious diseases which may be transmitted by vaccination—I mean the affections which are transmissible from animal to man, or *vice versa*, and those transmissible from man to man only, and from animal to animal.

Since we are more enlightened on the cause of contagious diseases, it frightens one to think that in vaccinating a child, other diseases worse than small-pox might be given: tuberculosis (consumption), for instance, the most mortal enemy of life, to say nothing of other still more loathesome constitutional affections. But if science has given us that dread by its light, it has, nevertheless, done a wise thing; it has by that means forced man to be prudent, and to search deeper into the nature of the preventive treatment adopted universally. It has led to the solution of the long-discussed subject of the origin of vaccine, and thus given us the means of producing a safer article. In fact, the knowledge that vaccine is horse-pox attenuated by its passage through the bovine system (cattle) is very useful in the cultivation of vaccine, which takes the name of cow-pox. As stated elsewhere in this paper, cow-pox vaccine and horse-pox are one and the same affection. This fact has been established by experiments of the most rigid character and approved by the French Academy of Medicine long ago. What was supposed formerly to be natural outbreaks of cow-pox had probably their origin in horse-pox, which existed simultaneously in the same localities. In fact, Jenner had recognized this, or at least he doubted such to be the case, as we can see from old writings.

I have the good fortune to announce to you that on the 10th of August, 1886 (the last month), horse-pox broke out in Montpellier, France; that a horse, found in perfect health otherwise, had a pustulous eruption on the lips; that the director of the Montpellier Vaccinal Institute (established in 1876) inoculated a fine healthy female calf with matter from that eruption with the greatest care; that on the 16th he reaped the purest vaccine from the calf and sent me five bottles of it, warranted perfectly pure and safe. All of that is attested to before the mayor of the city of Montpellier by Mr. Pourquier, director of the above named institution, and by Mr. Mauray, veterinary inspector of the department.

Thus it will be seen that the basis of our operations in producing vaccine for public benefit will be purely of animal origin and exempt from the germs of any human or animal affection. The outbreak from whence it is derived is so recent, and other care in its production so great, that we are absolutely sure of the article we will offer to the public to protect against the ravages of smallpox. When abroad I

studied carefully all that pertains to vaccination in general, and I am prepared to cultivate vaccine on the approved anti septic methods, which have for years back given splendid success to their originators and all who have put them into practice. Besides that, I am in direct communication with the old reliable Vaccinal Institute of Montpellier, where I can get all the information desired on new discoveries, and get a new supply of vaccine, it ever there is need for it. The public, physicians and boards of health may, therefore, rely on getting at our institution the safest and most active vaccine obtainable.

Regarding experiments for the preparation or research of other kinds of vaccine for diseases of domestic animals, I can only repeat that we can hardly do anything without a fully equipped laboratory and sufficient funds.

Before closing, I should like to say a few words in regard to the treatment of Mr. Pasteur against hydrophobia (rabies), were it only to answer in a general way the innumerable questions I am asked on the subject. But my report is already long—too long, perhaps, to begin this matter which does not interest us so closely, and which would add several pages to these. I will simply say that the treatment in question is a vaccination based on the same solid rock which constitutes the foundation of vaccinations used successfully in other diseases, *i. e.*, micro-organism, as the probable cause of rabies; the attenuation of the virus; its mild effects when so inoculated and the non-recurrence of hydrophobia.

I need not say a word in regard to the great scientist himself; he is now well known the world over. Dr. S. S. Laws, in his admirable lecture published under the title of Pasteur's life and labors, has not overrated the wonderful man who, in France, stands with DeLesseps, at the head of the legion of scientists of that country. I shall always consider it one of the greatest honors of my life to have pressed the hand of this noble genius.

I remain your humble servant,

PAUL PAQUIN.

COLUMBIA, Mo., September 9, 1886.

P. S. I might have included in the body of this report that I could have obtained a diploma of veterinary science from a French institution, if I had had sufficient time to prepare myself to pass examinations, in the French language, on subjects which were entirely strange to me, viz: veterinary medical jurisprudence, sanitary police and legal medicine, according to complicated French laws dating as far back as the year 1600, or about, and the practical art of shoeing, forging, etc.

As I was supposed to study contagious diseases in general, I could not spend any time on such subjects, which in our circumstances have no positive bearing in this country. In order to judge for myself of the workings of a French institution and its mode of examination, I was permitted to attend the latter personally by submitting to examination questions, as regular attendants. I consequently can give a good idea of the thoroughness of their four years' course of medical studies. I regretted very much not being informed in the sebjects above, according to French laws, etc., for, in the subjects proper to veterinary medical sciences, my notes or points would have granted me a legal certificate. P. P.

Since writing this report I read a very able article on contagious pleuro-pneumonia. It was a clipping from a Scottish paper, and published in the *Kansas City Live Stock Indicator* (recent number). The writer disbelieves in vaccination against this affection. Why is it, then, I ask, that at a few hours' journey across the waters from Scotland they succeed with this operation? Why is it that in France, where veterinary science was first taught; where the first veterinary medical institution was established; where now their teachings extend over four years of ten months each, and are under the direction of the authorities quoted and followed the world over; why is it, I say, that in this country vaccination against pleuro-pneumonia is practiced by those most eminent veterinarians of the world and is enforced by law and good results come from it? There is something strange somewhere. It reminds one of the two eminent physicians and professors of Montreal, who last year fought with all their might against vaccination in that city whilst small-pox was raging and making dozens of victims a day. They denied its efficacy and pointed to nothing to be obtained from it except accidents, or no effects whatever. Those physicians being of the highest standing, professionally and socially, simply amazed their fellow-workers, and their action did much harm. There will be anti-vaccinators at all times. P. P.

BULLETIN No. 25.

MISSOURI AGRICULTURAL COLLEGE,
COLUMBIA, MO., Dec. 7, 1886.

S. S. LAWS, LL. D., *President of the Agricultural College and University of Missouri:*

SIR—I hereby transmit to you data regarding several economic problems in ordinary farm practice. I indulge the hope that the time is near at hand when this farm will be able to carry all of its inquiries completely out; that is, that it will be able to consider all the phases of the question under consideration, and not be obliged, as in the first matter of this bulletin, namely: "Shrinkage of hay in stacks," to limit investigations. It is hoped that it may also escape from the necessity of considering only those questions that involve little or no cash outlay.

SHRINKAGE OF HAY IN STACKS.

Against my conviction that stacking hay is not an economical method of preserving it, I am forced to stack it in the open air according to the prevailing practice.

Hay contains in the dry, as well as in the green state, matter that is soluble in water. For this reason all exposed hay on the exterior of stacks is subject to having washed from it such soluble matter. In round stacks the amount of hay thus exposed is much larger than is usually supposed. A body one foot in diameter contains only one-fourth the matter that a body two feet in diameter does. Thus, six inches from the circumference toward the center will contain four times as much matter as the central part of a round body, two feet in diameter, will contain.

A stack of hay, twelve feet in diameter and six feet to the point of its drawing in, and five feet more to the top of its cone will contain on its outside foot, at 450 feet to the ton, 286.57 pounds of hay, while the interior will contain 580.49 pounds. Thus, 33 per cent. of the hay of

the ordinary round stacks of the state is found on the outside foot of those stacks.

A heavy proportion of this food is obviously subject to loss by leaching rains, by moulding, and by actual rotting in badly constructed stacks. It was said by one who handled hay during last year that one-half of the hay of his county was so damaged as to be virtually worthless.

August 9, 1884, I had put up a well made stack of second crop of clover. It was in good style to shed rain and capped with other material. It was built over rails laid down as a foundation, and all done up in about the usual style, save that it was perhaps a little below the ordinary size. Notwithstanding this fact it was not injured internally by water, as we often see in poorly made stacks. It weighed, August 9, on stacking, 6,514 pounds. It was tested for water content by the water bath and found to contain 32.5 per cent. of water. March the 3rd it was again all weighed with much care to prevent loss of hay in handling. Its weight was 4,548 pounds. At this time it contained 16.14 per cent. of water. The change in water content is quite noticeable, and places us, as was anticipated, under the necessity of ascertaining the dry matter of the hay, both in the fall and in the spring.

6.514 pounds less 32.5 per cent. water is 4,397 pounds—Fall weight of dry matter.
4.548 " 16.14 " " 3.814 " " " " "

Loss of organic matter until Mar. 23.... 583 pounds.
Per cent. loss for 7½ months, 13.2.

What would have been the loss from July 1, until May, when the last of winter food is supposed to be fed?

APPLICATION OF ABOVE FACTS.

Before drawing any conclusion, I wish to say that this is not sure to represent an average truth, yet at the same time the sampling of the hay was carefully made for water content.

First—The 6,574 pounds of hay in the fall would have been as well sold at $5 a ton as the 4,548 pounds at $7.16 a ton in the spring. This does not include interest and cost of handling, which would carry the spring cost up to $8 per ton to equal the $5, fall price.

These figures, of course, contemplate the sale of the hay direct from the field.

Second—The above figures of shrinkage for the stack in question does not include the injury to the hay on the bottom of the stack and the direct injury at other parts.

Third—The 13.2 per cent. lost was doubtless mainly from its more valuable portions; those portions that would be more easily digested, leaving all of the exterior of the stack off in aroma, available sugar, and richer in ratio of woody fibre. Hence, it would be eaten less readily, digested more poorly, and would give less growth, and white, and more poorly flavored butter.

Fourth—This 13.2 per cent. when applied to 100 tons of hay means a loss of 13.2 tons. This, at $6 per ton, which sum is less than the average price per ton of hay, as returned to this office for every county of the State, gives a money loss of $79.20. This sum is the interest on $1,320 at six per cent. For $1,320 a barn could be constructed in which water will not freeze, and that will hold 100 tons of hay, and cattle enough to consume it.

In this estimate it will be observed that I have made no claims for damage to hay otherwise than in loss of weight. I do not reckon this, for I am aware that loss may possibly occur under shelter, and that I may have in this trial more than an average necessary loss. I am sure that I have much less loss than that usually received.

SUGGESTIONS.

Experience and observation assure me that our loss from badly stacked hay is enormous and not in the interest of economy.

I would advise a moderately expensive barn. This saves the hay trampled out about stacks; it saves the manure; it decreases the amount of food eaten; it saves the lives of animals and the loss of hay from sources above considered. I am thoroughly satisfied that the above losses are the interest on very much more than the cost of a good barn.

(For a much fuller consideration of this subject of barns please send to subriber, two or three months later, for the annual report of our State Board of Agriculture).

To those who cannot secure barns, a cheap and successful system may be found in building broad, square, high stacks, and covering them with boards; a double layer of boards being used to cover the joints. The English thatching and other systems of covering are often available. Some one method or methods should have universal adoption.

DISTANCE OF PLANTING CORN.

The prevailing distance of planting corn is in checks four feet square, two stalks to remain in the hill. This gives 5,445 plants to the acre, provided that the stand is secured even.

On the rough estimate of a ear to every plant and 100 ears to the bushel, we get 54.45 bushels of corn as the probable maximum crop. This may be surpassed in years when twin ears abound and the size of the ears is great.

There should be a greater probability of crop than this. May not thicker planting be a partial solution of this question? I know of but few farm practices that have greater unanimity of opinion than the opinion that favors checks four by four feet, two plants to the hill.

I have constantly practiced thicker planting with the belief that it was the better way. It may be recalled that on this farm the practice was inaugurated of selecting corn from short stalks in order to crowd the plants more closely together. This method has not entered into our College Farm practice as it should. Yet experimentally it has been successful, as reported in a previous bulletin.

TRIAL OF DISTANCES.

During the past season the following test of the amount of corn plants per acre was made:

Six rows of corn of about 60 rods to the row were planted 4x4 feet, 4 plants to hill.
" " " " " " 4x2 feet, 4 " "
" " " " " " 4x3 feet, 3 " "
" " " " " " 4x2 feet, 2 " "

I did not personally supervise this trial during the planting, although I saw it well started. It was not perfectly done upon the above plan. It was further disturbed by insects or by cut worms.

At harvest the hills were carefully counted and stood in numbers according to the following table:

First six rows had 3,600 plants standing.
Second six rows had 5,208 plants standing.
Third six rows had 4,560 plants standing.
Fourth six rows had 3,132 plants standing.

Yield of first six rows was 1,194 pounds of ears—per acre 2179 or 31.1.
Yield of second six rows was 1,600 pounds of ears—per acre 2919 or 41.7.
Yield of third six rows was 1,594 pounds of ears—per acre 2907 or 41.5.
Yield of fourth six rows was 1,160 pounds of ears—per acre 2117 or 30.2.

If there was any difference in the quality of the land, it was in favor of the first six rows.

The variety of corn was the Thompson, a variety of average size.

The year is well known to have been a very poor corn year here, and one not favorable to thick planting. The ground is an upland soil rolling and inclined to be dry. It is the poorest tillage field we have on the farm.

In the report of the Board of Agriculture above referred to, will be found tabulations from several experiment stations of the results of planting corn at various distances. These results all favor planting thicker than is our custom here in Missouri.

This State grows 150,000,000 to 200,000,000 bushels of corn yearly. This subject, then, is an important one, and will bear the most careful consideration by farmers. The result got, as seen in the above table, in the second rows above the result of the first rows was 34 per cent. by the increasing of the number of plants 44.6 per cent. Such a change means from 50,000,000 to 74,000,000 bushels of corn difference yearly for our State, or for 100 acres 1,060 bushels.

The result may seem like a chance one to many. If the figures are compared they will be found consistent. Like differences occur between the third and fourth rows. Between the second and third rows little difference is seen. In the light of the results of the two outside sets of six rows, it appears that the third six rows had nearly enough plants, possibly not quite enough, while the second set of rows had possibly too many.

The number of plants per acre were for

First six rows, 6,576.
Second six rows, 9,503.
Third six rows, 8,321.
Fourth six rows, 5,717.

The lowest number of plants used per acre exceeded slightly the number usually advocated as sufficient.

It would have been interesting to have compared the influence of the number of plants in a hill on the yield, had the plan been strictly adhered to as originally laid out.

The writer is authorized to fix for our State Board of Agriculture the rules that shall govern the competition for the corn premiums which the Board will doubtless give for the following year, to the extent of several hundred dollars. Every competitor will be required to give data regarding distances of hills and of number of plants per acre. Those proposing to compete will do well to make a study of this question. In the trial above, the fodder was not weighed from lack of conveniences for weighing loads.

TRIAL OF VARIETIES OF CORN.

During the season of 1885 I tried fourteen varieties of corn. I used the most even piece of ground that I could find in a twenty-two-acre field devoted to corn. This was not of even character enough for critical work, although the ground was but very gently rolling with inclination in one direction. The ground was not underdrained, allowing of uneven moisture. Eighty pounds were considered a bushel. It was practically all sound corn.

Name.	Height of Plant in ft.	Time of Ripening.	Yield, Bushels.	Variety.
Flint Corn	8	Aug. 21	57.36	Longfellow variety, 8 rows, red.
Snow Flake	10½	Sept. 25	78.22	A white variety.
Chester County White	11	.....	84.43	" "
Long John	12	" 17	89.36	" "
Leaming	9	" 5	73.85	Yellow dent, early.
Turnbaugh	11 1-6	" 21	59	Yellow, large ear.
Iron	10½	" 14	68.8	Red, ear medium length.
Evans	12	" 14	84	[to 18 rows. Red and yel. med. to large ears, 16
Thompson	9	" 16	71.9	White, medium sized ears.
Golden Beauty	10½	Oct. 1	61.1	Yellow, 10–14 rows, medium size.
Beasley	10	Sept. 16	61	Red or yellowish red.
Farmers' Favorite	9½	" 7	61.3	
Unknown	12	" 7	61.2	

The season was wet and our main corn crop good. On ground surrounding the plats, I weighed out half acre tracts yielding ninety bushels per acre. There was but little difference in the yield of the Thompson corn and of the Evans corn in the field crop. These are the two varieties believed to be the best for this farm. It will be seen that these varieties yielded less than two other varieties in the plats. This is due to the fact that the over wet season affected the ground upon which these crops stood, as it did the other varieties about them. Yet it will be seen how much they shot up above the varieties on each side.

The character of the ground was very similar for the first six varieties, and for the last seven very much alike. All of the plats were similarly manured and otherwise similarly treated, the only visible difference being in the fact that the last named in the table were somewhat flatter and moister. In an ordinary season, or over a drained surface the test would have been quite equal.

Very respectfully submitted,

J. W. SANBORN.

BULLETIN No. 26.

AGRICULTURAL COLLEGE,
COLUMBIA, MO., February 5, 1887.

S. S. LAWS, LL. D., *President University of Missouri and Agricultural College:*

SIR:—I take pleasure in transmitting to you the following report of trials of varieties of vegetables and fruits in the Horticultural Department of the Agricultural College, under the charge of Prof. L. R. Taft, who has arranged and carried forward the work. The work in this department, as well as upon the college farm, is limited to such experiments as it can perform from its own net earnings. I know of no other similar institution in the country that is forced to limit such work to its resources, that are actually sending out results of such labors.

Very respectfully,
J. W. SANBORN.

HORTICULTURAL DEPARTMENT, MISSOURI AGRICULTURAL COLLEGE,
COLUMBIA, MO., February 6, 1887.

PROF. J. W. SANBORN, *Dean Missouri Agricultural College:*

SIR:—The experimental work carried on during the past year has been in much the same line as for the previous year, it being impossible to successfully carry out much more, as, during the months when the work must be inaugurated, my time was taken up with teaching in the class-room and on the grounds, or in attending to the commercial branch of the department, from which our support is derived.

The principal work has been in testing the different varieties of fruits and vegetables, especially the novelties, in order to determine their value. Our State is so large and has such a variety of soil and climate that varieties which do well in one locality are failures in another, and no general list can be given. The varieties mentioned here include those which have proved best on these grounds, and possess qualities which make them worthy of cultivation.

VEGETABLES.

During the early summer the weather was very favorable to the growth of vegetables, but the late crops were badly injured by the drouth which set in during the early part of July.

Beans.—Early Yellow Six Weeks was one of the earliest, and was not only very productive, but almost free from blight. Early Valentine ripens a week later than Six Weeks and is one of the best snap varieties. Its quality, productiveness and vigor of growth recommend it, both for home use and for the market gardener. Improved Early Valentine (Cleveland's) was found to be six days ahead of Early Valentine in ripening, and slightly more productive. Dwarf Horticultural suffered to some extent from blight, but was quite prolific. The Wax varieties are not only as vigorous as Valentine, but are of superior quality and very productive. Dwarf Golden Wax is one of the best.

As a pole or running bean, the Southern Prolific is a valuable late snap variety. The Early Cluster is superior in quality. Of the shell bean the Improved Lima is one of the best, but is more liable to injury from early frosts than the Sieva or the Large Lima.

Beets.—The Eclipse is a very early turnip-shaped variety, with a small top; as obtained from different seedmen, it varies widely. The old Egyptian ripens with Eclipse, but is flattened and irregular, while Crosby's Egyptian differs from it by resembling the Eclipse in form.

Bastian's Half-long is of an excellent quality, and is desirable both for summer and for winter use. Bassano and Dewing's Blood Turnip are well worth planting.

Cabbages.—Early Jersey Wakefield gave best satisfaction as an early variety. Landreth's Earliest was nearly as good, while the larger Henderson's Early Summer followed them closely as the best second early. The later varieties were badly cut off by the drouth, but their relative value was, Schweinfurth and Marblehead Mammoth first, followed by Stone Mason and Fottler's Brunswick.

Cauliflower.—The Dwarf Erfurt and Snowball give best satisfaction. Lenormand's Short Stemmed is also a valuable variety.

Celery.—Our warm, dry summers cause what is known as "celery rust." Hoping to avoid this, several hundred plants were transplanted to an empty cold frame, in rows one foot apart with five inches between the plants. They were watered occasionaly and made a strong healthy growth. They did not sucker, but from a single bud made a large plant, which took on a good form without handling. The self-blanching varieties, like the White Plume, are good for fall use, and the Golden and Pink Dwarf varieties answer well for winter.

Sugar Corn.—The Cory and Marblehead are much alike in growth, but the former ripens first by five or six days, and its ears are slightly larger. Crosby's, Moore's and Concord's and some of the Evergreen varieties, if planted at proper intervals, will carry out the season with a constant succession.

Cucumbers.—The White Spine varieties are valuable for home gardens. Early Russian is among the best early kinds, and Long Green is the best late variety. The Green Prolific is among the best for pickles.

Lettuce.—The Boston Curled and Tennis Ball are among the best for general cultivation. The Curled Silesia is an excellent variety for forcing, and Salamander is unequaled for summer growing. If plants of any of these varieties are transplanted in a rich soil, one foot apart, they will soon form large heads.

Onions.—The White Portugal and White Tripoli are among the best for sets, while the Silver Skin is one of the best early varieties to grow from seed, with Wetherfield Red for late.

Peas.—Seeds of the Alaska (Cleveland's) were received, both from the originator and from the Rural New Yorker, and proved to be from two to six days earlier than the other extra early varieties. The Alaska seems to be a distinct variety, and in yield and quality stands at the head.

The early varieties sent out by the leading seedmen of the country, under different names, are practically the same in growth, earliness and productiveness. One of the best of these is the Rural New Yorker, which is a vigorous grower with pods large and well filled. It gave its first picking two days after the Alaska. The other varieties are too much alike to be distinguished.

Carter's Extra Early Premium Gem is a dwarf variety, productive and of fine quality. The American Wonder is a valuable second early variety, very productive and excellent in quality. Bliss' Abundance and Hosford's Market Garden peas are branching varieties which proved to be very productive, some plants producing sixty pods. The seed should be sown six or eight inches apart in the drills. The Marrow Fats and Champion of England are good late sorts.

Potatoes.—The best of the varieties grown in 1885, and several new kinds, to the number of thirty, were planted for a second year's test. In order to obtain the best results, Northern Michigan seed was obtained. Our grounds suffered severely from the drouth, and all the varieties were more or less injured, the late ones especially. Early Harvest was the first to ripen, and also gave the largest yield. Early Mayflower and Lee's Favorite, closely followed. The yield of the late

varieties was not accurately ascertained, but White Star and Rural Blush were among the best.

Radishes.—The French Breakfast gave best satisfaction as an early variety; for general culture, Beckert's Chartier has no equal, as it is large, easily grown and free from woody fibre. Long Scarlet, Scarlet Olive and White Turnip are also good, the last being especially valuable for summer.

Squash.—The Bush and Crooknecks are still unsurpassed as early varieties. Essex Hybrid does well for fall, and Boston Marrow and Hubbard for winter.

Tomatoes.—Of the new varieties, Alpha and the Mikado, or Turner's Hybrid, are inclined to be irregular, especially if on rich soil.

Turnip.—The varieties given last year can not be improved on, viz.: Purple Top and White Egg for early, and the White or Yellow Globe for late.

SMALL FRUITS.

Strawberries.—Of the new varieties, fruiting for the first time on the grounds, Woodhouse was the most promising. The plants were vigorous and productive, while the berries were large, firm and of the best quality, better even than Hervey Davis.

Jewell made a strong growth, and bore a fair crop of good sized berries, of good quality. With the same care, Jersey Queen did as well in every respect. The Jewell plants made very few runners, not more than three being obtained from a plant, although neighboring plants of other varieties produced from fifty to one hundred each. Belmont plants set out in the spring of 1886 were allowed to ripen a few berries. They were of good size and color, but were inferior to the Woodhouse in quality; the plants seem very healthy. Henderson, plants strong and vigorous, fairly productive and of fine quality. Parry, plants weak, berries small and imperfect. Prince of Berries, strong grower and quite productive; berries large and good in quality. Emerald—This bids fair to make a good late variety; the berries are firm and of good size. May King—Quite early, but does not equal Crescent in productiveness.

A number of other new varieties promise well, but need further trial. The above were all grown in hills and well cultivated. What they will do in matted rows is yet to be determined.

Of the older varieties for ordinary cultivation, Cumberland Triumph, Capt. Jack and Crescent stand at the head. For matted rows, especially, they are all well adapted.

Miners and Sharpless are both of them good varieties, but are not

sufficiently productive here to be profitable, although in some parts of the State they are considered very valuable.

Jersey Queen and Daniel Boone, grown in hills, produced good crops of large, handsome berries, and proved valuable as late varieties. In matted rows the result was unsatisfactory.

Crystal City is the earliest sort grown, and will give a fair number of medium sized berries, for three or four days before other varieties are ripe. For home use or for local markets, where a good price can be obtained a few are desirable.

Hart's Minnesota, being a late kind, suffered from drouth, but gave a fair crop of berries. They were moderately firm, regular, and of good quality.

Two years' test has failed to find the following kinds productive, viz.: Big Bob, James Vick, Longfellow, Mrs. Garfield, Atlantic, Daisy Miller, Bidwell, and Piper's Seedling. The last two sometimes do well with high cultivation.

Raspberries.—Most of the varieties came through the winter without serious injury. Shaffer's Colossal was literally loaded down with fruit; the berries are of a large size and have a peculiar taste and color; they are not quite firm enough for shipment, but for private gardens and local markets it has no rival. Turner is more extensively grown than any other variety, as it has proved hardy and productive. Thwack is equally desirable, except that it is poorer in quality. Cuthbert has never proved productive on our grounds, but in some localities it excels the Turner, and on account of its being a better quality, it deserves a trial. Marlboro has, thus far, shown itself to be unproductive. Hansell is a valuable early variety; although not always hardy, and less productive than Turner, it is profitable in most localities. Crimson Beauty has not been hardy. Rancocas was injured by the dry summer.

Of the blackcaps, Souhegan and Tyler are among the surest varieties. Hopkins and Gregg are liable to winter-kill, but are among the best for general cultivation. Carman is a new variety which seems hardy, early and productive; owing, perhaps, to the dry weather the berries were small in size. Nemaha does not seem hardy.

Blackberries.—Snyder and Taylor were hardy and productive; the fruit was of medium size and of only fair quality. Western Triumph is hardy, but is not as productive, although the fruit is larger and of better quality. Kittatinny was slightly injured by the winter, and produced only a few berries; rust was only seen upon one plant. Early Harvest was killed at the tips; the fruit was early, but in small quantity. Agawam, Wilson's Junior, and Early Cluster, seem hardy, but have not fruited.

THE VINEYARD.

The results of this year's trial do not differ materially from those of last year. Rogers Hybrids, and all other varieties derived from crossing with *V. vinefera*, have winter-killed when left unprotected By laying down the vines and covering them slightly this can be prevented. With a good market, or for home use, the superior quality of these grapes will warrant the trouble. The other varieties were but little injured.

The black rot was less injurious than last year; for this a sure remedy will be found in bagging, if it is done when the grapes are the size of buck shot. They will also protect the ripe fruit from the attack of birds and insects.

By carefully removing the leaves, the diseased grapes and the trimmings in the fall, and burning them, most of the spores will be destroyed. Syringing the vines and ground with a strong solution of sulphate of copper, will also be found beneficial.

Elvira, Ives, Concord and Martha, have given best results. Worden, Moore's Early and Pocklington, are well adapted to some soils, but have not done as well as the other kinds mentioned, with us. Niagara and Empire State seem perfectly hardy, but are too young to fruit.

THE ORCHARD.

The experimental orchard is under your immediate care, but the following brief notes may not be out of place.

Pears.—Out of seventy varieties planted in 1881, only six have fruited, and three of these have borne two crops. They are Japanese varieties, known as Madam Von Seibold, Mikado and Daimyo. The first is of a deep russet color, nearly circular in form, with a long, slender stem, and is about the size of the Sheldon. The tree is a very strong grower and seems perfectly hardy.

The fruit of Daimyo and Mikado is of a bright yellow color. Two years ago the trees bore about a peck each, and last year they were loaded down with their golden fruit. The fruit resembles small oranges, except that it has slender stems three inches long. The flesh of these varieties is too coarse for table fruit, but their early bearing, productiveness and apparent freedom from blight, render them especially valuable for canning purposes, for which the fruit is well adapted. Furthermore, their appearance for a month or more before ripening, reminding one of the golden apples of the Hesperides, makes them valuable as ornamental trees.

De la Clime 1405, produced its first crop last year, but the fruit was too small to be of any value, owing in part, no doubt, to the dry weather. The other varieties fruiting were Le Conte and Kieffer. The fruit of Kieffer was so coarse as to be hardly eatable when ripened on the tree, but when carefully ripened in the house it was of fair quality. The principal value of these varieties, as grown in this State, will be for canning purposes.

A number of trees on the horticultural grounds gave good crops this year, among the best being Summer Doyenne, Clapps, Flemish Beauty, Seckel, Howell and Duchess. During the past two years no blight has shown itself. The trees are in sod, and a normal growth is secured by means of decomposed stable manure and unleached wood ashes, and the trees have been carefully thinned to prevent over bearing.

Apples.—One hundred and ten varieties of apples were planted at the same time as the pears, nearly all of them were new sorts, except a few of the old kinds which were scattered about, to serve as standards of comparison. Ben Davis, Winesap and Huntsman bore good crops last year, but none of the new varieties produced any perfect fruit. For family use in most parts of the State, the following will be found a good selection, viz.: Early harvest, Red June and Golden Sweet for summer; Rambo, Maiden's Blush and Smith's Cider for fall; and Grime's, Golden, Jonathan, Janet, Huntsman, Winesap and Willow Twig, for winter. For shipping purposes nothing answers as well as Ben Davis.

Plums.—The Wild Goose varieties gave a full crop, but the location is not suited to the European sorts, and very few are in a satisfactory condition.

Cherries.—Early Richmond and English Morello are the only kinds that do well here, although in favored spots the Duke varieties can be grown successfully.

Mulberries.—Several trees of Russian were black with fruit, and the *Morus alba* also gave a fair crop. The trees are rapid growers, and furnish valuable timber. The berries are two-thirds the size of the Snyder blackberry, and are valuable for canning. The trees can be cheaply obtained, and for the fruit grower or market gardener a few would prove a good investment, as the fruit will draw the birds away from the peas and strawberries, and thus prevent serious ravages. Downing's Everbearing produces better fruit, but will not prove hardy in all localities, Respectfully submitted,

L. R. TAFT.

BULLETIN No. 27.

FEEDING FOR FLESH.

MISSOURI AGRICULTURAL COLLEGE FARM,
COLUMBIA, Mo., February 17, 1887.

S. S. LAWS, LL. D., *President University of Missouri and Agricultural College:*

SIR:—This report will detail results of the fourth attempt to study the effects of the influence of food rations upon the character of the growth of the animal fed. The first three trials were made with pigs, in order to ascertain whether the proportion of lean in a pig might be very materially increased, and at the same time be occompanied by as rapid a growth as when the best of fattening rations are fed. The result was a most radical difference in ratio of lean to fat, while the growth of those fed for flesh was slightly more than those fed for fat. This difference extended to the vital organs, hair, etc.

FEEDING CALVES.

The following trial with calves was entered upon in September, before the experiment with the breeds was arranged for as noted at the close of this article. After the arrangements for said test, the one now recorded was continued as preparatory to the future trial, which will be on a broader scale, and more exhaustive in character. The present test, however, covers many important points, was satisfactory in the main in its issue and confirmatory in full of previous results, and productive of new suggestions.

September 1, lot one of two calves weighed 340 lbs. Feed: clover hay, new process linseed meal and bran, and 10 lbs. skim milk, each, daily; bran and oil-meal fed in equal quantities.

Lot two was fed with timothy hay, new milk, 10 lbs. each; flax seed and corn meal. The concentrated food was one-quarter flax seed and three-quarters corn meal.

The ration for lot one was intensely albuminous, or flesh making, every food in the ration being rich in albuminoids. The ration for lot two was highly carbonaceous, every food being carbonaceous in character except the new milk which was necessarily fed. The fat, or cream, was removed from milk of lot one, and not for lot two, thereby giving to lot two milk better calculated to produce fat.

As calves have a strong tendency to develop muscle and little for fattening, if we succeed with a food so largely tending to the growth of muscle as new milk is, and where it is so material a part of the ration as in the food of lot two, then we can control the proportion of fat to muscle, at will, in older animals that have a natural disposition to take on fat, and that are not necessarily fed milk.

At first, the calves ate the flax seed very poorly, which accounts for the lessened concentrated food consumed by lot two.

Consumed by lot one for 104 days, to slaughter: clover, 245 lbs.; 726 lbs., equal parts of new process linseed meal and middlings, and 2,080 lbs. skim milk. Gain, 375 lbs.; gain per day, 3.68 lbs.

Lot two ate for 104 days, 245 lbs. timothy, 170 lbs. flax seed, 511 lbs. corn meal, and 2,080 lbs. of new milk. Gain, 370 lbs.; gain per day, 3.54 lbs.

	Wt., Lot 1.	Wt., Lot 2.
September 1	340 lbs.	320 lbs.
" 16	390 "	382 "
October 1	430 "	420 "
" 15	500 "	490 "
November 1	560 "	540 "
" 15	630 "	610 "
" 29	710 "	684 "
December 13	715 "	690 "
Gain	375 lbs.	370 lbs.
Gain per day	3.68 "	3.73 "

COST OF FOODS.

	For Lot 1.	For Lot 2.
245 lbs. hay at $6.00 a ton	$0 73	$0 73
363 lbs. linseed meal at $25.00 a ton	4 54	....
363 lbs. bran at $12.00 a ton	2 17	....
2,080 lbs. skim milk at ¼ cent	5 20	....
170 lbs. flax seed at 2 cents	....	3 40
11 lbs. corn meal at $14.00 a ton	....	3 57
2,080 lbs. new milk at 1 cent	....	20 80
Total cost	$12 64	$28 55
Cost per lb. of growth	3.3 cts.	7.7 cts.

This experiment was in nowise tried to test the economy of foods, nor to note the most productive foods, but to establish a most important law upon which feeders can forever base the principles of food combinations for a given end, namely: To ascertain the influence of the ratio of albuminoids to carbohydrates fed, to the character of growth. Cheaper and better growth can be made than upon the above foods. Nevertheless, lot one made both good and profitable growth when confined to a pen, without access to grass. In ordinary years such growth is worth 5 cts. here. Again, lot two, compared with lot one, shows two important truths, to wit: That skim milk can be made as effective in a ration for growth, in a practical way, as new milk is; also, that new milk calves, as now grown by the mass of farmers, are very costly calves. Milk is not produced for less than 2 cts. a quart, even where the calves draw it direct.

ANALYSIS OF THE FOODS GIVEN.

I again thankfully acknowledge my obligations to the Chemical Division of the Department of Agriculture at Washington, for the analysis of the foods fed. Missouri has failed to provide the means to carry forward such analyses at the Agricultural College.

	Water....	Ash.....	Crude fat.	Nitrogen free extract....	Crude fiber....	Alum'ds	Non-albuminoid Nitrogen.
Middlings.....	11.82	3.27	4.25	59.83	3.07	17.76	.....
Corn Meal.....	12.63	1.38	4.36	70.60	2.10	8.93	.....
Timothy hay.....	7.20	5.54	2.84	47.88	29.35	7.19	.11
Clover	8.05	7.28	3.02	44.68	23.16	13.81	.22
Flax Seed.....	6.25	4.63	37.92	15.37	10.34	25.50	.....
New Process Linseed Meal	11.13	5.85	4.86	38.48	5.62	34.06	.....

DIGESTIALE NUTRIENTS—FURNISHED EACH LOT.

	For Lot 1.				For Lot 2.			
	Albuminoids....	Nitrogen free extract...	Fats	Nutritive Ratio..	Albuminoids....	Nitrogen free extract...	Fats....	Nutritive Ratio..
	Lbs.	Lbs.	Lbs.		Lbs.	Lbs.	Lbs.	
245 lbs. Clover.....	18.60	97.07	3.77	1:5.7	.....	.....	.....	.....
363 lbs. N. P. Oilmeal.....	101.35	120.71	16.05	1:1.5	.....	.....	.....	.....
363 lbs. Bran.....	50.10	185.41	13.78	1:4.3	.....	.....	.....	.....
2,080 lbs Skim Milk.....	78.00	88.40	10.40	1:1.5	.....	.....	.....	.....
245 lbs. Timothy.....	.....	.....	.....	.....	10.52	129.60	3.23	1:13.0
170 lbs. Flax-seed.....	.....	.....	.....	.....	37.28	28.63	59.01	1:4.5
511 lbs. Corn-meal.....	.....	.....	.....	.....	38.32	343.23	16.81	1:10.0
2,080 lbs. New Milk.....	.....	.....	.....	.....	83.20	88.40	72.80	1:1.3
Total.....	248.05	491.59	44.00	1:2.4	169.32	579.86	150.85	1:5.5

First. I note that the ration of lot number two is one of a very fair proportion of albuminoids to carbohydrates, or a good growing ration, and not calculated for fattening. I should have added sugar, or some other carbonaceous matter, to the ration, instead of flax-seed. The milk was necessarily given in order to promote growth at the size of the animals, without which, the trial would have been of comparatively small value. Under the above ration, if a marked difference is

noted in the composition of the meat of the two lots, it will be quite conclusive, and will show that greater differences may occur under wider variations in character of food.

Second. The milk is estimated in composition from cows of similar breeds and may vary slightly the proportion of the nutrients, but is of no importance, as it can vary the ratio of the whole but the merest fraction.

Third. I call the attention of farmers who are not familiar with the chemistry of foods and their combinations in food rations, to the varying proportions of albuminoids to nitrogen free extract (better known as carbohydrates), and to fats in foods. The table given illustrates the ease with which we can vary the proportion of these materials given daily to our animals. The present theory of animal nutrition asserts that animals at varying ages and kept for various purposes should, as a matter of fact, have different proportions of albuminoids to carbohydrates given them. This is doubtless true. This phase of animal nutrition is one of the most important that our farmers can master, and one that involves many millions to our State yearly. This is not the place to present the question in detail. I will say that the faculty of our College of Agriculture have been contemplating a short course of two or three months in agriculture for the special instruction of farmers who may desire to attend them, and master something of the philosophy of feeding, soils, etc. I hereby invite all those who feel inclined to attend such course to so write me, that we may ascertain whether there is any encouragement to go forward with the purpose.

Fourth. I again call attention to the relation of the growths and rations given to the German theory of nutritive ratios. This is the eleventh year that I have been unable to make my facts accord with the doctrine of these German physiologists. While it is the best working theory we have and contains elements of great value it needs most serious and critical experimental study and reorganization. I would not again risk wearying the reader on this point if the public were not still offered, from certain reputable quarters, tables of food combinations based upon this theory, and which tables find their way into our Missouri papers. The principle has undoubted value of great moment, but is not yet capable of being expressed in mathematical tables. The two rations above make the same growth, both of them good growths, yet one contains, by the theory alluded to, very nearly the right proportions of nutrients, and yet on 15 per cent. more food makes the same growth as the ration badly out of balance. Had the deficiency in ration One been in albuminoids the result would very likely have been ultimately different.

The dressed beef carcass, as will be seen, does reveal a profound difference in the character of the growth, although it does not in amount of said growth. The character of this growth has never been taken into account by the views entertained and is really in discord with them.

DRESSED WEIGHT OF CALVES.

	Lot 1.				Lot 2.			
	No. 1.		No. 2.		No. 3.		No. 4.	
	Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.
Blood	14	14	15	2	13	3½	11	14
Liver	6	12	5	10	5	2	5	8
Heart	1	11½	1	11½	1	10	1	12
Lungs	4		4		4	10	4	2
Tongue	1	5	1	3½	1	7	1	4
Hind Quarters	84	8	100	12	97	12	86	8
Fore Quarters	89		97	8	87	2	90	6
Hide	32	12	34		30	8	30	
Stomach	60		55		59	8	59	6
Spleen		7½		10		15		12½
Head	10	6	10	14	10		11	
Feet and tail	7	12½	7	13½	6	12	8	7½
Fat	3	3	3	11	5	8	3	
Intestines	23	6	20		18		17	14
Kidneys	1	5	1	1½		13½		14
Loss	7	9	7	7	7	4	7	
Total	715 lbs. 6½ ozs.				690 lbs.			

OBSERVATIONS.

I. Although lot two did not receive a fattening ration, yet the small amount of fat on the intestines and vital organs was 23.6 per cent. more than was found upon lot one, while the kidneys were much fatter. The flanks and parts of the quarters where fats are deposited in layers, was most markedly more fatty than the same parts of lot

one. The uncooked meat was submitted to ten competent gentlemen, comprising the Visiting Committee of the General Assembly, and others. Without exception they selected sections of lean meat that carried the most fat among its fibres, fat or "marbled" in, from the carbonaceous fed lot. They each detected without hesitation after the meat was cooked that which was fed for fattening, although none of them knew the feeding of the live animal. The difference could be readily told by cutting without seeing and by mastication with the teeth. The meat of lot one was distinctly more fibrous in character and showed a denser fibre without the light streaking of fat.

The meat of each lot was weighed for cooking in order to note shrinkage during cooking. I found that an oven of an ordinary stove will not answer for such a test and so have no reliable figures.

II. The kidneys weigh 36.6 per cent. more in lot one than in lot two. This is in accord with the trial with the pigs. Also it is noted that the liver was greater with the albuminous fed lot, than with the more carbonaceous fed lot, again agreeing with the former results, although less marked. These organs are more engaged when the animal is fed with an abuminous diet than when fed with a carbonaceous diet and like a blacksmith's arm grows larger by exercise.

III. One of the best illustrations of the subtile influence of diet on the structure of the animal is seen in the greater weights of the hides of the more albunious fed lot. Hides are albuminous in character and this increase of the weight of hides is in harmony with the increased weight of hair found with the pigs under albuminous diet, and as well as anything can show it, shows that we can make our cattle lean or fat at pleasure. But it is said that any one can make steers lean as "Job's Turkeys." But I seek large ratio of lean with rapid growth and a fine market steer with the maximum of lean, for our steers as now fitted for market carry a mass of layer-fat. The average buyer for consumption knows less what to do with it than with fat pork. A roast of fat stock show aninal was about one-half thrown away at my table from excess of fat.

I was concerned last year in the disposal of fat stock show animals at Kansas City and found that butchers were reluctant to handle the animals, saying that their customers did not like them on account of the waste fat.

IV. A difference in the lungs is noted, but the most significant difference in the present stage of ignorance of the function of the spleen, whose office is unknown, is the increased weight of the spleen in the more carbonaceous fed animals, or 57.1 per cent. the heavier of the two sets. Surely the probabilities are that the spleen has some-

thing to do with the carbonaceous elements of nutrition. At this point, however I sent the following letter to Dr. Paquin, Professor of Veterinary Science of this College:

COLUMBIA, MO., February 17, 1887.

PAUL PAQUIN, V. S., M. V., *Prof. of Veterinary Science:*

DEAR SIR—Will you be so kind as to give me the result of your observations upon the character of the blood of the two lots of calves fed upon the college farm to note the influence of food on the character of their development?

I find a very wide and uniform variation of the weights of the liver and kidneys of both hogs and calves due to the method of feeding. But with the calves I note a fact that, so far as I know, is new, viz: that the spleen of both calves of lot one, fed on albuminous ration, is decidedly of less weight than those fed on the more carbonaceous ration, amounting to 60 per cent. more in the latter lot than in the former, or as 17½ is to 27½ ozs. Knowing that physiologists are much in the dark regarding the functions of this organ, I desire to ask if this data may not throw some light upon the matter, and that you will briefly give me any data that will be of interest to science, or of use in this connection.

Very truly yours,

J. W. SANBORN.

ST. LOUIS, MO., February 24, 1887.

PROF. J. W. SANBORN, B. S., ETC., *Dean Missouri Agricultural College:*

DEAR SIR—Your letter of the 17th reached me when I was very busy, and just preparing to leave on official business—hence my delay in replying, and my reply coming from this point (St. Louis). I think I have explained that my notes on the blood you refer to, have been rendered unreliable by the action of some chemical substances accidentally spilt over them in my absence from the laboratory. As far as I can recollect, the blood from the calves fed nitrogenous material, appeared in the test tubes, more watery and more fibrinous, and the solid portion proper of the blood in a smaller quantity, than the same in the blood from the carbonaceous-fed subjects. But the blood naturally differs so much in many instances in ordinarily fed animals, especially between males and females, I am not prepared to give any definite opinion from these imperfect data, although the microscopical and other studies that I have made with that blood have impressed me,

that the physiological relation existing between that fluid and the food assimilated may perhaps be controlled to a certain extent. The enormous difference in the spleen of the animals fed by the two processess is striking, to say the least, and may result in putting us on the right track as to the functions of this organ. This diverticulum, of a more or less erectile nature and constituting a vasculary sanguinous gland, is supposed to manufacture white corpuscles and to do many other things. But in fact little is known of its true object yet.

I hope that you may again repeat your very interesting experiments, and that by a preconcerted arrangement we may be enabled to study the blood and spleen carefully and accurately. I regret sincerely my inability to furnish you better notes this time.

Your humble servant,

PAUL PAQUIN.

V. During slaughter the stomach contents differed much in color, being lighter in lot two. There was also noted with lot one a most remarkable twitching of the muscles, which seemed much more marked and prolonged than with lot two. This observation was somewhat casual, and came too late to make any scientific investigations. The writer is familiar with slaughtered animals, having witnessed them by the hundreds, or running into larger figures, and believes that he does not err in the observation. Such phenomena might be expected from a physiological standpoint.

VI. There is an increased weight of blood in lot one over two. The letter of Dr. Paquin calls attention to its character.

VII. I selected cuts of the lean meat from each animal from precisely the same spot, namely: The thigh, the shoulder and from the loin and placed them in the hands of Professor Paul Schweitzer, of this college, who very kindly offered his services for analysing the samples. I received from him the following data, for which I hereby tender my thanks.

	Lot 1.				Lot 2.			
	No. 1.		No. 2.		No. 3.		No. 4.	
	Water per ct.	Fat per ct.	Water per ct.	Fat per ct.	Water per ct.	Fat per ct.	Water per ct.	Fat per ct.
Shoulder.....	75.68	0.59	75.61	0.21	74.55	1.65	75.19	2.14
Rib and Thigh..	74.01	0.58	75.32	.50	73.81	.39	73.88	1.32
Flank.....	75.98	.81	76.34	.82	73.40	1.15	76.13	0.50
Average.....	75.22	0.66	75.38	.51	73.94	1.06	75.07	1.32

The table is self-explanatory. Prof. Schweitzer states that the fat is likely too low in every instance, as he had not sufficient time for extraction of the fat. The figures are certainly very low for fat, as foreign figures give much more fat for calves. The kineys showed more fat for the corn-fed lot than for the other lot, as the following will show:

	Lot I.		Lot II.	
	Water.	Fat.	Water.	Fat.
Kidney.....	77.56	0.69	77.52	3.17

REVIEW.

I. These figures show that calves can be successfully and profitably grown without skim milk.

II. Calves whose growth is mainly muscle, when fed with ordinary muscle-making food lay on more fat than calves fed on foods calculated to grow more muscle, or more albuminous foods.

III. The vital organs were most materially changed in weight by varying foods, this change extending to the skin and to a radical degree affecting the spleen.

IV. It is probable that the blood was materially influenced and that the muscular energy was much increased by a highly albuminous diet.

V. The lean meat was more dense and harder with the albuminous-fed lot.

VI. These facts, taken in connection with the trials with pigs clearly show that on cattle approaching the fattening period a radical difference in ratio of fat to lean can be made, while yet securing rapid growth and obtaining an animal with a large ratio of lean meat.

VII. They demonstrate, when considered in relation to the prior trials, the great uncertainty of the influence of breed on marbling, as shown at the dressed carcass rings at our fat stock shows.

VIII. The next trial will be with more mature animals, and with funds sufficient to pursue the matter more fully.

FEEDING EXPERIMENTS WITH THE BREEDS.

The earlier experiments of the writer convinced him that food may have more influence on the character of the meat in its marbling, and otherwise, than is manifested in breeds of different cattle. For this reason, he has held that the slaughter rings of our fat stock shows, which are regarded as the supreme test of the relative merit of the breeds in the production of good meat, are of but little importance for the purpose in question, and likely to teach errors. The experiments by him for the last four years have shown such to be the case beyond question.

To eradicate the influence of food and thus to leave standing out clearly, breed influence; to ascertain the amount of food required to grow a steer, and the amount required to grow a steer of each breed; to ascertain the relative rapidity of maturing; to ascertain the period of life at which each breed grows best, and the season of each year it does best; to learn the cost of growth at each succeeding month of life, the weight of the various parts of each of the breeds, the character of the marbling of the meat of the breeds, the influence of food on that marbling, the relative value of foods for good meat and for other purposes, I appealed to the four national cattle breeders' organizations, which met during the Chicago Fat Stock Show, and which represented the Short-Horns, Herefords, Aberdeen-Angus and Galloway breeds, to give to the State Agricultural College of Missouri, ten thoroughbreds of each breed, to be selected by experts named by each of these associations, for their own breed. This request was granted by every association, with a generosity and public spirit that is worthy of admiration, for these animals are come to us from the very best stock of the country, and represent thousands of dollars capital, necessarily sacrificed by castration. I should say that the Holstein-Friesian Association are contemplating adding ten of their breed. This trial brings together forty of the best animals ever fed for experiment, and the best of the world, and in such numbers as to make the results representative. I need not enlarge upon details in this direction.

The conditions upon which the cattle will be received are as follows: First, they are to be selected by a committee appointed by

these national organizations. Second, they are to be castrated before being received, and I recommend that it be done at about two or three months of age. Third, I recommend that no extra forced feeding be resorted to before shipping, as the result would be deleterious, if the ration should prove superior to the one fed by us. At the season in which the owners will retain them, the mother's milk will be the chief diet. During the latter part of the period, grass or early cut clover and timothy may be eaten with linseed meal, oatmeal, bran or middlings, and a little corn meal. However, I will not assume to dictate the feed, and have not yet fully laid out my own rations. It will be best to have them fed alike before coming here, but not necessarily so. I shall be pleased to receive suggestions from the owners as to feed while still in their hands, upon which a subsequent circular may be issued.

The cattle will be received about September first, and may be from four to six months old. This age will not be exactly adhered to, but the ages must approximate four to six months. Doubtless ten of each breed will average nearly alike, if some latitude is given, although the nearer alike the better. The animals must be males, and all be eligible to registry.

On the part of the college no expense will be spared in securing impartial and exhaustive work. The microscope, the chemical laboratory, the veterinarian, the scales, the butcher, and the meat consumer, and any other aid needed, will be brought into requisition to secure full and important work. Especially in the weighing of food and of the beasts throughout, will the conditions be painstaking and guarded. I need not recount all the conditions. Probably some animals of each breed will be slaughtered before maturity for study. Some, or perhaps most, will be retained at least until weighing 1,500 pounds. A section may be fed in barns in summer, to obtain the exact food eaten, while others may graze to note results. In winter a few of each breed may be fed in the open air. Not everything involved can be tested well in one trial, but the most important points can and will be considered.

Very respectfully,

J. W. SANBORN.

THE DESCENT OF DOMESTIC ANIMALS.

AN ADDRESS BY PROF. J. W. SPENCER, M. A. PH. D., AT FULTON AT THE FARMERS' INSTITUTE MEETING HELD IN THE WINTER OF 1885–6.

The relationship existing between between many of our domestic animals and their congeners in the wild state can rarely be connected by the evidence of direct descent from common ancestral forms. The absence of this proof arises in part from the effects of domestication and artificial selection upon the original forms and their descendants, and in part, from the probability that many of our useful animals are the products of the inter-breeding of several closely related species, yet in many cases, generic if not specific relationship can be traced back a long way in geological time.

Of the horse family, there are found six distinct species: The horse proper, the African and Syrian wild asses, and three striped species of South Africa, known by the names of Quagga, the common zebra, and Burchell's zebra. Passing back in geological time, the bones of many horses and horse-like animals are found as fossils in the mud or dried up marshes and other places where they had died. Before the Eocene period of geology, nothing is known about the ancestry of the horse family. But with the dawn of that period there were numerous hoofed animals roaming over the plains of America and Europe, and these were, even then, specialized into the "odd-toed" and "even-toed" Ungulates.

The best idea of these ancient odd-toed ungulates may be seen in the tapir, which is the most generalized form of the group still living. The complete number of teeth is: three incisors on each side and on both jaws, one canine, four premolars and three molars, in all, forty-four teeth. Again, in the hind foot the symmetry is complete, with

one large toe in the center, and one small toe on each side. In the fore foot there are four toes out of the symmetry of five, wherefrom one of the outer toes is absent.

From such generalized forms, which alone are found in the early Eocene period, the differentiation of horse like animals can be traced through various stages down to the highly developed race horse of the present day.

The earliest horse like animals are supposed to have had five toes on each foot, but none such have been found in the fossil state; yet there is a near approach in the skeleton of the Eohippus of the older Eocene period. Although this little animal was no larger than a fox, yet in general structure it was horse-like, but it had four toes on each hind foot, and four together with a rudimentary fifth toe on the fore feet. In the late Eocene period there lived a similar animal of about the same size, which had not the fifth rudimentary toe on the fore foot, and on the hind foot there were only three toes. To this form the name of Orohippus, or mountain horse, has been given.

The next advance was to the Mesohippus, an animal as large as a sheep. It had three toes on the hind foot, but the fourth toe of the fore foot was degraded to a splint. This form was followed in the later Miocene period by the Miohippus of the same size as the last, with similar feet, but with the splint bone of the fore foot reduced to remanant. In the Pliocene or next geological period, there was a marked advance in these horse like but small animals, for there were then numerous horses called Protohippus or Hipparion with three toes on each foot, and these were as large as a donkey. Immediately following these animals in the later Pliocene period was introduced the true horse or Equus, like the modern horses with one toe or single hoof, but with a splint bone on each side.

Wild horses roamed in great numbers over the plains of Europe and North America, but in this country they became extinct before the introduction of the Indians.

The most ancient wild horses of Europe, that were contemporaneous with the earliest human inhabitants of that continent, were the descendants of these late Pliocene forms, and lived under the favorable conditions of pasture clothed steppes in place of the growing forests which afterwards spread over the country and restricted their ranges, or finally drove them into Asia. These earlier horses were strong, thick headed animals, having a height of about five feet.

Amongst the earlier remains of human habitations in Europe are those of villages built on piles in the Swiss lakes and elsewhere. These people, however, did not inhabit Europe until in the Forest age when

the country had become clothed with trees. Horses were domesticated by the inhabitants of these village-dwellers, but they were of small stature, not reaching a height of more than forty-eight to fifty-two inches, with light frames. Not only are their remains found, but on the bone carvings of the Neolithic or newer Stone-age-people, they are represented with shaggy manes similar to the wild horses of the steppes of Russia of the present day.

These horses were of deteriorated structure, and may have arisen from the scarcity of food in a forest-covered country and from the effects of domestication by savage races, which so commonly results in degraded life for the animals, as well as for the people themselves.

From the earliest Egyptian records it appears that the ass was domesticated in that country, but the earliest known reference to the horse is much later; yet its use is recorded as far back as thirty-eight centuries ago.

There are two primitive races of horses very different from each other—the Oriental and the Western.

To the Western race belongs the Friesland horse, including the Brabant, Holstein, Mecklingburg, English farm horse and the French Percheron. These heavier horses, so different from the Oriental, where not interbred, are regarded by some authorities as the descendants of the early European horses, which flourished before the forest epoch of that continent.

Of the Oriental races, there are several varieties, as the Arabian, Berber, Audalusian and Neopolitan; the English blood horse, and the Nizaischan of the Deccan of India, which includes the Persian, Turkish, Turkistanian and Tartarian. The English blood horse is descended from the "Turk," brought from near Smyrna, in Asia Minor, and the "Barb," an African horse north of the Sahara.

None of the domesticated horses are known in the native state. They are generally larger in size than the other species of the family which are wild. The conditions of climate and food, as well as artificial selection, have led to greater modifications. Thus the Shetland pony of the north, as well as the larger horses of the south, are traceable to common ancestry. The effects of artificial selection in this country is seen in the race horse, where the speed has increased from a mile in three minutes, in 1818, to a mile in 2:8¾ minutes.

Domestic species very soon revert to a wild state when left to themselves. The wild horses of the pampas of South America are the descendants of twelve individuals of Audalusian stock brought to that country about the middle of the sixteenth century by colonists, who themselves perished. Another example of reversion to a wild

condition is seen in the Tarpans, or so-called wild horses of southern Russia (north of the Sea of Azov), which are supposed to be descendants of domesticated animals allowed to run wild about two centuries ago. There are several varieties of wild horses north of the Himalaya Mountains in Asia, but they do not show near relationship to our domestic varieties.

Very often some monstrosity is seen in our domestic animals which can be explained as a case of reversion to some ancestral forms, even though belonging to many previous generations. Sometimes they are stupid like South African species, as if both were descended from common ancestry. Spots are only modifications of stripes. Another apparent case of reversion, which we call a monstrosity, is the presence of one or two extra hoofs developed from the splint bones, as is occasionally seen. A rarer abnormality has been seen in the presence of a horn-like projection upon the frontal bone of some colts at birth.

The characteristics of the ass appear to be less variable than those of the horse, for the relations of the domestic varieties can be easily traced to the wild ass of Abyssinia, with which it is probably identical, having been domesticated by the Egyptians from the most ancient historic times.

The Syrian or Asiatic wild ass has a redder color, wants the dark streak upon the shoulders, but has the medial dorsal stripe and possesses smaller ears. This species roams from the Caspian Sea to Thibet, and the individuals vary in appearance. They are very fleet, even more so than horses.

The wild asses are much more beautiful than domestic varieties.

The other species of the horse family before named are all striped, and are confined to South Africa, these being the quagga and two species of zebra.

Most of the species of the horse family have been crossed, and the hybrids may be seen in the *Jardin des Plantes* in Paris, and also in London. Whilst mules and hinnies are not fertile among themselves, yet with some pure blood, on either the side of the horse or ass, some females have been known to reproduce. Although hybrids, by artificial selection, may arise, yet in nature such are not of common occurrence; as, for example: the different herds of striped horses of Africa, although pasturing on the same plains, do not intermingle. Even in South America different herds of the same species of wild horses do not have any associations, although the Tarpans of Russia occasionally entice away from the region the domesticated mares.

From what we have seen, although much of interest is known, yet

we are not able to complete the geneology of our horses at the present time, owing to the variations produced by domestication, and owing to the imperfect records connecting them with the past.

Swine belong to the even-toed ungulates or hoofed animals, and like other non-ruminating species have typically tuberculated teeth corresponding to their omniverous habits. One of the six genera of the family is that of *Sus*, which includes the domesticated hog and several wild forms. The typical dentation differs from that of the old odd-toed Ungulates by the reduction of one premolar. The family is regarded as the most generalized of the numerous even-toed hoofed animals, which some individuals consider to have been descended from ancestors in common with those of the odd-toed—the even number of toes arising from habits of the former animals living in swampy grounds, and the odd from those living in dry grounds, and supporting themselves mostly upon the middle toe until its development was ensured by its exaggerated use.

The domesticated swine have not arisen from distinct species, but have descended from at least the *Sus Scrofa* or wild boar of Europe, now living only in the eastern part of the continent, and the *Sus indicus*, the progenitor of the Chinese domestic pig. The wild relatives are larger than the domesticated; they are not gregarious and the boars usually live solitary lives, rooting or obtaining their food at night. The tusks which are the canine recurve, assist them in rooting as well as being weapons of offence or defence. Unlike the domestic varieties the wild swine are very fleet. Domestication also reduces the size of the ear, and the size of the tusks, no longer needed in defence and in obtaining food. The body becomes larger but the legs shorter and more fat accumulates. Also they become gregarious and diurnal in their habits. They easily revert to many of their characteristics of the wild state, including the stripes on the young—a marking as common among Ungulates as if all of them had been descended from striped ancestors.

Another anomoly is in the structure of the foot, consisting of the union of the last joints of the middle toes into a solid hoof, thus reducing the animal to a three-toed variety. The other species of the genus *Sus* are mostly confined to Southeastern Asia and Malay Archipelago, while the members of the other genera of the swine family are variously scattered over the world.

The ox family belonging to the even-toed ungulates or hoofed group, furnishes us with some of the most useful of our domestic animals. Unlike the omiverous pig, they are runimating and have the crowns of their molar teeth double crescent—formed and adapted for grinding their food. They have been domesticated from high antiquity, mention

being made of their utility in the Egyptian, Hebrew and Hindoo records more than four thousand years ago; besides the evidence of their use found amongst the relics of prehistoric lake-dwellers of Switzerland and elsewhere, belonging to the Neolithic period. There are two primary groups of cattle, the humped backed or zebus (*Bos-indicus*) of India and Africa, and the straight-backed (*Bos taurus*).

In the pre-historic times there appear to have been three or four species co-existing in Europe, namely: The *Bos primogenus*, *Bos longifrons* and the *Bos frontosus*. The two former species were mostly wild, and the last was probably the domesticated ancestor of many of our modern cattle. The first of them, the *Bos primogenus*, roamed from Britain and Italy to Siberia. It appears also to have been domesticated by the Swiss lake-dwellers. Its head was a yard long, and the horns three and a half feet across. In some parts of Europe this animal continued to be an object hunt until the middle of the sixteenth century. The last of these, the Polish Tur, (which some consider to be a hybrid with the European Bison), died in 1627.

Several continental breeds of cattle, as those of Friesland and of Pembroke in Britain, are supposed to be descended from this *Bos promogenus* or *Urus*. But to-day the only near approach to the ancient animals are the wild white cattle of Britain, now preserved in four parks, of which those of Chillingham are the purest. They have been living there since the thirteenth century, but may be considered only as degenerate descendants of the ancient mighty *Urus*, being of much smaller size. Some, however, regard them as descendants of domestic cattle reverted to the wild state.

There are only a few individuals still living. In the agricultural museum of the State University, is a pair of these skins mounted, which are the only specimens in America. A similar breed existed in Wales in the tenth century and later. That they were abundant, appears from a gift to King John of England, of 1,400 head.

Bos longifrons lived wild in Sweden. It was of smaller size than that of ordinary cattle, and had short horns. It was domesticated in Europe at an early day, and appears to have been the food for Cæsar's army in Britain, where its remains are found associated with the extinct elephant and rhinoceros. The Welsh and Highland cattle are supposed to represent its descendants. The *Bos frontosus* existed in Scandinavia, and was probably the ancestor of the mountain cattle of Norway. Its remains are found amongst the relics of the Swiss lake dwellers of the Bronze epoch. Its bones are also found in Ireland.

Of the forty or fifty breeds of cattle, most of them are undoubtedly varieties arising from varying conditions of climate and food, together with interbreeding and natural selection.

The present wild cattle of South America are descended from eight individuals of Andalusian stock turned loose at Asuncion, in Paraguay, about A. D. 1856, and these have given rise since that time to several varieties, from polled cattle to hairless forms.

Whilst there are several species of wild cattle in Asia, and closely related forms, there are none properly so called belonging to America, as the American buffalo or bison, although nearly related, can not be considered as a species of *Bos*. Yet, in the fossil state, the remains of ancient cattle are frequently found showing their former habitation in this country.

Sheep belong to the same sub-family as cattle, although very different in appearance. In the region of the Himalaya Mountains in Asia, there are eleven species of wild sheep. Outside of this region there are a few other species in the old world, and in America one species in the form of our mountain sheep. The domestic sheep is not the representative of a single wild species, but of a whole group or series, and probably originated in Asia. None of the domestic animals is so liable to sudden introduction of unusual character which may be perpetuated, or so liable to vary from differences of climate and food as sheep.

Whilst most of our domestic mammals belong to the ungulates, or hoofed animals, we still have two others which, although less useful in supplying our wants, are much more companionable, namely: the dog and cat.

Of the dog, the great naturalist, Cuvier, showed his exaggerated appreciation, when he said that "the dog is the completest, most singular and useful conquest ever made by man," and perhaps with greater truth, our Byron records him as "in life the firmest friend."

The relations of the domestic dogs to their wild congeners are clouded with the same mystery as those of our other domestic animals. Some regard the dogs as descendants from extinct forms, but of the relations to the fossil forms nothing is known; and others regard the domestic dogs as a blending of several species or varieties. Again, they have been classified with jackals; but most investigators regard them as modifications of wolves, which have a close affinity. Almost everywhere dogs are found to be the companions or servants of even savage or semi-civilized man. Nor is this a modern state of affairs, for their remains are found with those of the people of the Neolithic or newer stone age of Denmark and Switzerland. The domestication, and even adoration of the dog was recorded on the Egyptian monuments from 3,000 to 5,000 years ago. Under the name of Anuibis, the son of Osiris, the dog was worshiped as the god or spirit of the Nile,

and even the jackals were regarded as sacred. The Greeks and Romans esteemed these animals, but the Hebrews and Mohamedans considered them as degraded. The same still holds true with regard to the miserable pariah dog of Indian cities and Egypt, which is owned by no master, and prowls about the city in search of even the most miserable food, or lives upon public charity.

In many countries the dogs of the uncivilized races are only native wolves or jackals which have been tamed. Thus the Esquimaux dogs, used as beasts of burden, and as such are of great value, bear such a close resemblance to wolves as often to be mistaken for them. Furthermore their masters attempt to improve their stock by the infusion of fresh wolf blood. The Hare-Indian or Machenzie River dogs bear a similar resemblance to the prairie wolf. Again, the Hungarian shepherd dog bears the closest resemblance to Indian wolves. The pariah dogs are said to have a close resemblance to jackals.

Huxley considers that the wild dogs of Siberia, of the Deccan and of Sumatra, as well as the hunting dogs of South Africa are only modified and enlarged forms of the jackal type. The miserable dogs of Central Africa are distinct from any European variety. In tropical countries, the jackal replaces the wolves of the temperate and northern climates.

Fitzinger classifies the dogs into six races, the wolf dog, the greyhound, the spaniel, the hound, the mastiff, and the terriers. The close relationship is shown in that all of them, as well as the wolf and jackal, freely interbreed so far as known; yet there appears to be some distinct variations, as the naked dog of Peru.

Darwin concludes that domestic dogs are descendants of two good species of wolves, together with two or three doubtful species from Europe, India and North America, one or two species from South America, together with several races of jackals, and one or more extinct species. Such polygenetic origin for our dogs is not to be considered remarkable when we observe that one hundred and eighty-nine varieties have been recognized.

The value of the wolf-dog is known to us from its use in Artic travels, a team being capable of dragging a load for a distance of seven or eight hundred miles in fourteen days, even when fed upon scanty rations. In northern regions where there are no regular stations for rest, the wolf-dog is indispensible in traveling, as no domestic horse could endure the fatigue. In the northwest territories of Canada said animals are sold at fifty dollars each, or command as high a price as Indian horses. The sheep-dog is classed in the same race as the

wolf-dog. Of its faithfulness a noble example is recorded in a remote corner of Texas, when, after his master's death in his cabin, the dog still continued to drive the sheep daily to pasture for two years, feeding upon them as occasion required. But in the meanwhile the cared-for flock had largely increased. The Newfoundland dog is not an indigenous race, but a descendant of the wolf-dog of Labrador, and a larger species brought from Europe by the Norsemen a thousand years ago, or else by the earlier discoverers about the close of the fifteenth century. The pure bred is now very scare even in their own country. These are amongst the most sagacious and useful of dogs. Another large and noble animal is the great St. Bernard dog, now getting to be equally scarce, such as are kept at a convent near the dangerous pass in the Alps of the same name, where, during storms travelers are apt to be lost in the snow. These dogs are sent out from the convent in pairs, one with a flask of spirits, the other with a cloak. They will not only dig unfortunate travelers out of the snow, but will guide them to the convent. Should the traveler be unable to proceed with them, they bring assistance by their loud barking. One dog which came to an unfortunate end, wore a medal stating that he had saved twenty-two lives.

The distinct race of Greyhounds goes back at least 3,000 years, as shown on the Egyptian monuments.

The Spaniels or water dogs, are amongst the most beautiful and intelligent animals of their species. They were introduced into Western Europe from Spain.

The Mastiffs, including the bull dogs, pugs, (these being abnormalites), the old English Bloodhound, etc., have a long ancestry and were commom in Britain during the days of the Roman Empire, and were imported into Rome for fighting purposes. There is no more stubborn or vicious beast than the bull dog, and in a contest will not of itself yield to defeat. One of these dogs in a fight with a bull lost a foot at each fresh attempt, but still continued until completely disabled.

The terriers are small dogs, but belong to a race of as great antiquity as the last group. They are of principal use in the destruction of small animals such as rats.

Whilst there are several varieties of good breeds not mentioned here, but included in the general races above mentioned; yet few of our dogs are more than miserable mixtures of several types.

Let us now turn to the last and most domestic of our animals—the intelligent, affectionate, unobtrusive and much vilified companion of a cozy home—the cat. Whilst we do not find evidence of domestication in the remains of the inhabitants of the Stone age, yet the Egyptian monuments 4,000 years old show that it was then an object of adoration.

Fifteen hundred years before our era, a temple was dedicated to the Goddess of Cats.

The cats were sacred to Iris, or the moon, and I have seen their mummified remains, as well as those of the jackal. When cats died a natural death, the inhabitants of the house would go into mourning. A remanent of the ancient attachment is still seen in Cairo, where there is an endowment for the purpose of lodging and feeding homeless cats. There are three species of cats found amongst the Egyptian mummies, two of which are still living, both wild and domesticated. Yet neither these nor the Nubian gloved cat, which is in size and some other characteristics near our animals, can be shown to be in the ancestral form.

The Greeks obtained the cat from the Egyptians, and the Romans also had it, although the Roman ratters were martins. The Chinese veneration for the cat is almost equal to that of the Egyptian, and they imagine that the spirits of their ancestors, whom they worship may be wandering about in the form of this animal. Throughout the middle ages fabulous prices were paid for cats. The effect of this care as to breeding is seen to day in Italy, where live the finest varieties and in numbers most abundant—occupants of every house, in place of the miserable curs of our own country. Although the cat appears to have been first domesticated in Egypt, yet many naturalists conclude that the common cat is the product of many species, modified by intermingling with the local wild species of the countries in which they live. The fertility of such crossing is well known in many cases. The wild cats are generally of much greater size. Domestic cats may be easily made to revert to the wild state, and so doing assume the coloring of wild species. That the cats are subject to variability is seen in some insular varieties, such as the Maux cat, which is tailless. Tailless cats also occur in Crimea. The best known breeds are: the tortoise shell or Spanish cat; the bluish gray or Chartrene (among the mountains of southeast France); and the Angora or Persian cat, which is supposed to be descended from a short-tailed Asiatic cat, and has a dusky white color; and the Tabby, which is the gray cat, more like the wild cat of Europe.

There are several other less familiar forms, such as the heavy eared cats of China; the red of Tobolsk; the twisted tailed of Madagascar; the Meublos cat of Africa, with hair in place of fur; the nearly naked cat of Paraguay, etc. Between none of them and the original wild stock have we any more direct connections than between the more common forms and their polygenetic ancestry.

CONTAGIOUS DISEASES.

An address delivered at Kansas City, Mo , on the 28th of November, 1886, by Dr. Paul Paquin, Professor of Comparative Medicine, etc., at the Missouri Agricultural College and State University.

MR. PRESIDENT AND GENTLEMEN: The subject I am about to discuss with you is that of contagious diseases of live stock in connection with prosperity of commerce. My brief career in the State of Missouri, my being almost unknown to the majority of those composing this intelligent and influential audience, and my being comparatively young in the medical field in its relation to live stock matters, will cause some of you perhaps to feel that I have undertaken a task of too much magnitude. I confess, gentlemen, that I at first approached the subject with hesitancy. But on studying it more closely, and becoming more and more convinced, and reflecting on the necessity of a better understanding of contagious diseases and their multiplied disastrous consequences, I have come to the conclusion that the issue was accessible and resolved to appear before you and reason it. Having occasionally heard, to my regret, expressions denoting a certain want of confidence possessed by a few in the competency of those engaged in the study and treatment of contagious diseases of lower animals, I desire to say first that I have not come to boast of knowledge, that I have not come to preach any doctrine for personal motives, but I have come simply to lay before you, before an audience which I expected would be—as I see it is—composed of men directly interested; of men representing in a great measure the wealth and prosperity of Missouri and the surrounding States; of men who, by their experience in live stock matters, are eminently competent to appreciate any discourse pertaining to this interest; have come, I say, to present to you facts relating to contagious diseases, which are, I fear, misunderstood by

some, and, fortunately perhaps, willfully ignored by others. I stand before you as the advocate of a cause interesting the whole of our country, and among this audience I hope to find some one who will condescend to debate, while the others will constitute the judges and jury. My ambition goes no further than to have the opinions I will express discussed, criticised and considered without prejudice or partiality, and that they may be of some benefit to you and the country. I shall feel honored and happy if I have accomplished this much.

CONTAGIOUS DISEASES IN GENERAL.

What are contagious diseases? A discussion of this point seems almost uncalled for since so much is said and published daily about them. Yet if we reflect we will ask ourselves, what are they? We all know that they are transmissible affections; we all know that they spread more or less rapidly; we all know that they kill, and that very few are curable; and yet what are they? We feel that there is something more about them; there is something about the common nature of contagious diseases in general which puzzles our senses; there is a problem which we dare not attempt to solve, so incomprehensible does it appear at first to our mind. In a word, there is, it seems, a we know not what, that troubles our intellect whenever we attempt to conceive of the exact nature and of the origin of contagious maladies which now exist in this world. Could we not, by reasoning, let a slight ray of light in this obscure chamber? Let us see. The definition of all contagious diseases may be given as follows: Affections apt to propagate themselves by the means of certain specific agents which by their development and multiplication in the body cause more or less disturbance of the system, and often serious illness and death. What constitutes those specific agents which are so pernicious? They are constituted of various kinds of germs, called microbes, which are apparently of a vegetable nature. (It seems that very few now think that some are of animal nature.) Those germs, which are invisible to the naked eye, but are appreciable with strong optics and by a laboratory process, exist in the matter commonly called virus or contagious substances.

The word germ in connection with the causation of contagious disease sounds as a myth to the ear of many people, because, on account of their minute volume, it leads one to think that it is a cloak to cover ignorance. But not so. Myriads of microscopic living germs, or vegetable and animal cells and mineral dust float in the atmosphere we

breathe, the water we drink, and cover the food we eat, as well as the ponds, fodder, and pastures of live stock. They can be almost as plainly seen with proper instruments as we can see with our naked eyes the organic and inorganic particles of little larger size. Darken an ordinary room, allow just a ray of light to penetrate the obscurity, and stand aside. You will see a cloud of floating dust which contains dead and living cells of every description. These are immensely large particles compared to some microscopic ones which float amidst them in greater numbers still, and among whom we may find some capable of causing disease. Those infinitely small living bodies, whether offensive or inoffensive—for some are harmless—must find something proper to nourish them, make them grow and allow them to reproduce their like. The great majority find suitable food in the external world, and soil for growth in the tissues of the body, and thus cause disease. All microbes are, comparatively speaking, extremely prolific and rapid in developing. Thus it has been established—and this by observations and by certain laboratory process is of the most reliable kind, and which can be easily repeated—that several diseases of man and beast are

CAUSED BY CERTAIN GERMS,

which are introduced into the system through the respiratory organs, the genital organs, the digestive apparatus, or by inoculation, and there grow and multiply in the regions that contain, in sufficient abundance, the elements necessary for their life. The old theory that the growth of germs is the effect and not the cause of disease has no more grounds for its maintenance since pure separate germs cultivated in artificial preparations year after year, have been found capable of producing contagious disease by inoculation. The process of vegetation and germ life in the system which, as I said, is wonderfully rapid, is accompanied, like any other similar but visible operations on earth, by the production of chemical substances, which accumulate more or less rapidly in the tissues. These products may be poisonous and thus assist the germs in disturbing the system. Therefore, we are led to believe that the immediate cause of the lesions found in contagious affections, is the combined action of the germs in particular, and the chemical poison generated by their growth, perhaps cannot grow freely in the animal system, unless it be in the intestinal canal where myriads of many kinds may be found, and where perhaps their presence is needed for the process of digestion. Unfortunately it is not so for every kind of germ. Some find their nutrition and most favorable conditions for their multiplication and death in the tissues. The in-

conceivably large number of these parasites continually multiplying, for a time probably produce inflamation mechanically, by the irritation due to their presence, and may be by their individual irritative properties, while they perhaps assimilate, besides large quantities of certain special elements necessary to animal life. Thus the tissues and blood are altered and their destruction is probably hastened by the poisonous secretions of the microbes. The whole process of reproduction, life and death of those microscopic organisms, in the system of individuals, is a kind of fermentation.

You will observe, however, that there must be some difference in some the physical nature and the natural properties of disease germs, for are transmissible through the air and others only by direct contact; and some disorganize or decompose the blood, whilst others act on other tissues only or chiefly. Contagious pleuro-pneumonia germs, for instance, may float in the atmosphere and attack a subject at a certain distance from the center of infection, and the lesions found are chiefly in the lungs and pleura; whilst Texas fever and anthrax are never taken by any other means than by direct contact with the germs deposited in some place or other, and the lesions found are chiefly in the spleen and the blood.

The diseases due to volatile virus, like pleuro-pneumonia, are generally called infectious, and those due to fixed virus, like Texas fever and glanders, are called contagious.

PLEURO-PNEUMONIA

and several other maladies are both contagious and infectious. As the difference is not rigourous, we usually give the name of contagious diseases to all that are transmissible from subject to subject directly or indirectly, by any means. In fact, there must always be contact with a virus to effect the transmission of a contagious or infectious disease.

The life of germs like the life of plants, is more or less tenacious according to their nature. Some die in their soil when they have grown and have exhausted the materials proper for their formation, others, like anthrax germs, for instance, may even in the same circumstances, generate seeds (spores) which preserve the power of vegetation indefinitely, as we will see further. Many kinds of germs may preserve their vitality like that, for a certain time anywhere in special conditions, just as germs, like cereals or other kinds, may be preserved in a box. Like all plants too, the microbes may be altered in their vitality, indeed they may be weakened or destroyed, partially or totally by various agents, such as heat, severe cold, light, etc. Dry air

may dessicate them, damp air may favor their putrefaction, whilst other atmospheric bodies and some chemical agents, such as ozone, oxygen in way of fermentation, bodies having a great affinity for water bodies having the property of dessicating (drying excessively) acids, alkalies, electricity, caustics, etc., may favor and accelerate their destruction. This fact explains in a measure the mildness of certain contagious diseases in certain countries, and their intensity in others. We will come on this point again.

On the other hand experiments and observations have shown that miasma—animal emanations freed from the body of healthy or unhealthy people or animals, or animal and vegetable matter in decomposition, such as may be found in ponds, marshes, manures, etc., and which contain sulphureted, ammoniacal and carbonic gas and watery vapors, are favorable soils for the preservation and even the multiplication of micro-organisms. Besides it is well proven that woolen goods, furs, hides, old timber, debris of all kinds, may harbor them. Thus some germs may live in the body, outside of the body, or both; and others perhaps outside of it only, but all may be transferred from place to place by the influence of air, heat, rain, or in articles fit for their growth, or capable of preserving them, and perhaps all may be cultivated in the laboratory. This constitutes the essential points of the germ theory.

The problem which has annoyed so many who tried to explain contagious diseases by this theory is the appearance of the first germs on earth, and of the first contagious disease. Many students of nature turned away in disgust, and gave up the subject as an impenetrable mystery. In fact, search any work on contagious diseases, and you will observe that the essential parts of this point have been carefully avoided or are treated lightly. Would you not accuse me of audacity if I ventured an hypothesis on this point, when so many far superior intellects and servants has so far ignored it, totally or partially? Considering that there are errors which, by the researches and discussions they occasion, turn out as profitable to science and the world as veritable discoveries—I will risk it.

I will presume that my audience is composed of men believing and others disbelieving in the doctrine of the creation of all things in the beginning by an Almighty hand, and will leave aside for the sake of harmony in discussion, the religious principles which may be involved, and might be brought to bear on my opinion.

I say then that no matter what the various members of the immensurable family of the universe may consider the truth as to the origin of all things,

ONE FACT STANDS UNSHAKEN

By any theory or doctrine, it is that all living organisms which are visible might be traced back as far as human intelligence can conceive without finding the exact moment of their origin, and that all have individual creative powers. We can never prove that a single entirely new animal or vegetable has been created since the origin of mankind, although evolution may have changed the volume and appearance of some, and no new living matter can originate without that natural creative power of life. Now if this be true, let me ask are the smallest organisms, the microscopic individuals to be excluded from this natural order of things? Are they not living objects endowed with the faculty of reproducing their like? Is it not rational then to conclude that they have originated where the larger organisms have, and are consequently as old as they in the world? This is my humble opinion.

This being granted, you may say then, from the beginning of animal life all contagious diseases must have existed. If we had on earth germs of diseases when man and animals appeared, these beings must have been subjeat to their destructive effects from that moment.

It is difficult to decide this question, but in order to elucidate it, let me bring to your memory and explain more fully what I said in the beginning regarding the soil in which many germs are known to grow, and then we will see whether a rational deduction can be formed.

We know that many microbes that grow in the tissue of animals and thereby cause disease, can grow also outside of the body in artificial preparations of various kinds, and that innumerable harmless ones grow, so far as our information goes, only outside of the animal system, or in the digestive tube. This fact alone would perhaps justify us in considering all disease germs as capable of living and reproducing their like in soils to be found in the external world, just as plants do. But the fact that stagnant or still water, such as may be found in pools, swamps, marshes, filthy ponds, clay soils, etc., etc., are veritable dissolutions of mineral and vegeto-animal matter, and constitute very suitable soils for fermentation and the multiplication of various kinds of micro-organisms, are additional and stronger arguments in favor of this opinion. In those damp insalubrious places, during warm weather when fermentation is more active, and the multiplication of germs more rapid, a great quantity of watery vapors is freed carrying in suspension microbes of several kinds, which once in the atmosphere, may be blown away in various directions under the influence of cur-

rents of air and solar heat, and thus be sown in other soils. At night when

THE VAPOR CONDENSES ITSELF,

it falls to the ground dragging with it the organisms that were carried in the space at the mercy of the winds. By these means germs might multiply and be carried from swamp to swamp, from one fertile soil to others, perhaps without meeting for a time, any animal system suitable for their life, and thus live generation after generation in the external world. On the other hand, if such germs in their flight should fall on soils improper for their vegetation, they might preserve their creative power for years, for Pasteur, the great French chemist, has demonstrated by experiments of the most reliable nature, that certain kinds of disease germs can remain years in a dormant state, like oats or other grains in a garret, and then grow, if sowed in proper soil. Pasteur, in order to prove this, put animals to graze in fields where he had years before buried the carcases of beasts which had died from the effects of charbon (anthrax), and where no living subject of any kind had been kept since. Those animals contracted charbon and died. He searched the earth and found that the earth-worms carried the spores of charbon from the neighborhood of the carcass to the surface of the ground, where they were taken by the grazing beasts.

Judging from this, it seems fair to suppose, I repeat again, that all other germs of contagious disease could and can now find proper soils for their growth outside of the animal system, or may to a certain extent preserve their creative power, when deposited in soils containing none of the elements necessary for their vegetation, nor any destructive to their life. Consequently I believe that contagious diseases have existed since the moment man or animals offering suitable soils crossed the path of the infectious microbes, or germs wherever they were, but that knowledge of makind was not such as to explain them. The origin of contagious diseases then would date from time immemorial. The plagues and scourges of ancient times, which depopulated the world by the millions, and which are pictured with so much horror in ancient histories, were in all probability nothing but contagious diseases now in existence.

Leprosy, perhaps the most frightful disease of the human race, existed as far back as the ancient Egyptians and Hebrews, and still exists in various parts of the globe. We have descriptions of it in the earliest historical writings as being then considered as a malediction of God, sent as a punishment for the wickedness of mankind; and we read of its occasional occurrence now-a-days in the warm climates. This disease is also

DUE TO A GERM.

Armauer Hansen has proven that it is due to a parasitic agent. Consequently these germs must have existed in antiquity, or else leprosy itself could not have existed.

Contagious pleuro-pneumonia in cattle, which creates now so much disturbance in circles of live stockmen and agriculturists in this country, and which gives rise to so many conflicting comments and arguments, was described by Columella, who lived as far back as A. D. 40, and by Tacitus, 55, A. D. The specific virus of this disease also must have existed then, or the disease could not have been. Numerous other contagious diseases of man and beast now in existence, and known to be due to germs, have been described by the earliest historians. Those diseases could not have existed then either if their germs had not been in the world.

At this point there are three questions which come to our mind: The first is, why contagious diseases are not as common now as centuries ago? The second, Why the same contagious maladies are more prevalent and more fatal in certain countries than others? The third, If the germs can not originate spontaneously, how can diseases appear suddenly, as they occasionally do, in places where they did not exist before for years, and perhaps were never known?

I think that contagious maladies do not prevail as much now as centuries ago, because the progress of civilization bringing forth scientific discoveries and applying hygienic measures, has destroyed the means of propogation of the germs by the alteration of their most proper soil, which existed in the virgin world and its populations. In our days, when the disease germs are gradually thrown off the system of diseased men or beasts during life, or when they leave it after death, they are forced by present hygienic laws and healthy surroundings to fall on ground less proper for their prolification than in former days. True, they may on such grounds preserve their creative properties for a certain time in a dormant state, as I said before, and then develop, if sown in proper media; but by the same influence which gradually weakens and finally destroys the vitality of ordinary seeds and grain kept in reserve, and renders them powerless to grow, so the microscopic germs, if kept too long in an inactive state, must weaken with age and finally die. This has undoubtedly diminished the prevalence of contagious diseases.

Civilization has not only improved the surroundings of the people, and thus done away with many infectious centers, and the innumerable germ breeding holes which existed, but it has taught man to avoid being himself, as well as his beasts, the medium of germ vegetation.

As to the second question, Why are the same contagious diseases more prevalent and more fatal in certain countries than others? Allusion has already been made to the reason, it finds its solution, it seems to me, in the fact that many agents existing in the atmosphere are capable of

WEAKENING THE GERMS

and destroying them partially or totally. We have seen in fact, that dry air, light, heat, water, cold, dampness, alkalies, acids, electricity, ozone, oxygen in way of fermentation, etc. etc., have all to a certain measure, the power of affecting them. As the various countries of the earth differ greatly in temperature and the elements in their atmosphere, it is a natural consequence that certain germs which can live and grow but poorly in some of them, may multiply rapidly in others, just as for the same reason certain plants are entire failures in certain parts of the world and yet may flourish in others. Besides this, may there not be in certain animals of the same species some unknown difference in the intimate principles of the body? This point is very obscure. Certain we are, however, that the same disease in the same locality may effect a man or an animal, and not affect its immediate neighbor of the same species and breed, or will affect him more mildly. It is the case in contagious diseases. Again we see the same disease less fatal in certain breeds than others of the same species. This seems to be the case with hog cholera, which is apparently more fatal with certain kinds of hogs than others. Pleuro-pneumonia which is said to kill 60 per cent. of its victims in some countries and only 20 per cent. in others. May not animals of the same species, as well as men, present richer soils than others for the development of the same germs? May not their individual vigor or the vitality of their tissues also counterbalance in a measure the pernicious action of the germs? These suppositions seem to me rational. At least they seem applicable in certain circumstances. An animal already sick with ordinary chronic affections, for instance, or weak in constitution, appears to be on account of the alteration of its system, very suitable for the growth of certain microbes, while strong healthy ones may sometimes resist the influence of the same a long period. In contagious diseases there is a fight for existence between the vegetable cells or germs which seek their nutrition in the animal tissues, and the animal cells composing those tissues and found in the liquids, and repairing them by their constant reproduction. This does not say that certain cases are refractory to certain contagious diseases without the aid of atmospheric or other injurious influences on the germs, but it explains partially the chronic

cases, and thereby to a certain extent, the difference in fatality. For instance, we have glanders in horses, which is due to germs. We find many chronic cases even among fine and fat stock. When we kill animals so affected, we most always find

TUBERCLES IN THE LUNGS

and sometimes beautiful cicatrix of the lesions, which in their multiplication, the germs had made. Those cicatrices are formed by the production of new animal cells. Thus, during the action of the germs of glanders in their most active stage of growth, and during which they imflamed the tissues of the lungs, assimilated some of their principles and secreted poisonous elements—the power of animal life constantly produced new animal cells in greater quantity than usual for the repair of damages in the lungs; they fought for their property and food; many of them died in the battle, but finally the remaining ones with the new ones, succeeded in patching up the breaches. Hence, a cicatrix in the lungs. But the germs being kept at bay by the power of life it seems, and having considerably diminished their indespensible material, have not left the grounds entirely; they drag a miserable existence here and there in the system where they now find but poor soil for their growth and inferior food for their nurishment, and thus constantly besiege the unfortunate animal, like beggars at a kind rich man's door. The ultimate results of this constant fight may be some complicated troubles of various organs, weakness and death. Such is a case of chronic disease. Perhaps the same thing in substance might be said in regard to many chronic cases of contagious affections. For my part I think that they are all due in a great measure to the incapability of the infectious germs to overcome entirely, by the action of all their properties combined, the power of life and multiplication of animal cells; whether this inability be due to the weakness of the germs before their penetration into the organs, the poverty of the food they find, or the extraordinary vigor of the invaded system.

The third question, regarding the sudden and seemingly mysterious outbreaks of contagious disease where, perhaps, it never existed before, can be reasoned by several facts which have been discussed in this address. The principle ones are the various means by which disease germs may multiply themselves, be preserved in vitality for a long time, and be carried at a distance. Diseased animals which may appear healthy, infected clothes, hides, residues, manures, cars, ships, etc., etc., may very easily carry contagious germs from country to country, entirely without our knowledge. Those germs may multiply

in their new country or locality even outside of the body, or preserve their life until at a given moment, a living subject presenting proper soil crosses their path, and the disease is started. This animal is a new center of infection. Germs will grow in him, will be thrown off from his body by the lungs, the organs of secretion, the digestive apparatus, or by several organs combined, and finally by the death of the subject, and may spread further by the various means already described. The more suitable the surrounding world for their growth and preservation, the more dangerous the locality for an indefinite time. And besides, do not men themselves frequently hide as long as possible from the public certain facts which might lead to the origin of an outbreak of contagious disease and thus clear up an apparent mystery?

The influence of filthy places and the like have often been denounced as the cause of contagious diseases. Indeed, filthy holes, marshes, or any place giving rise to miasma, effluvia of vegetable, animal or mineral matter, have a great deal to do with them, but not in the sense generally understood.

SUCH UNHEALTHY CONDITIONS

cannot give rise to contagious disease unless they contain some of their germs. To illustrate this, we will imagine two small rooms of same capacity; one is occupied by twenty healthy men, who sleep with closed doors and windows; the other is also occupied by twenty men, who sleep in the same condition, but among them there is one with smallpox. Now you go to the first room one morning and you will breathe an odor which will suffocate you; it is the miasma thrown off the human body. You may go there every morning and you will always experience that offensive, suffocating smell. You may get sick, but it will not be a contagious disease; it will be due to the chemical and animal matter breathed.

Now you go once or twice to the other room in the morning; you will experience the same unpleasant suffocating smell again in breathing; you may be sick, but this time it will be contagious disease—it will be smallpox. In this case the germs of smallpox were mixed with the miasma, or exhalation of the body. The same principle exists in regard to all other infectious affections. Thus you see in what circumstances miasma or emanations may become contagious or infectious. We may apply this principle to stables, pastures, ponds, food, etc. The filthy homes, pools, stables, marshes, ponds, clay soils may foster the germs and favor their growth and spread, but cannot cause living organisms to sprout out spontaneously. No process on earth can generate live bodies, be they ever so small, without the natural creative

power of life. And germs of disease are, I repeat, living bodies, lying in the borderland of the animal and vegetable kingdoms. Experiments seem to prove that they belong to the vegetable world. No more than a stalk of corn can grow spontaneously in the earth without the germination of the seed previously sown, can microscopic plants sprout spontaneously in an animal or anywhere else without the germination of their like previously deposited there. Because germs of disease are invisible to the naked eye, and consequently difficult to appreciate, we are loath to believe in their nature and properties. But when one can take them from a diseased subject or a dead carcass of man or beast, and grow them in artificial soils entirely outside of the animal system, and there produce thousands of generations year after year, and then by an invisible particle of the thousandth generation introduced into a healthy subject kill it with the disease that the original germ produced years previously, it seems almost illogical to doubt. We can now cultivate disease germs of many kinds, as well as inoffensive ones in artificial media, in artificial fields, and watch them grow like a plant in a flower pot. So, gentlemen, we are justified to believe that contagious maladies are perhaps all of parasitic origin, for we are certain that all those which are clearly explained are of that nature. Thus the sudden and apparently mysterious outbreaks of contagious diseases may be accounted for by the numerous means of dissemination and transportation of the germs and their power of growing and keeping in vitality for indefinite period outside of the animal organism. We may conclude, therefore, that the spontaneous occurrences of contagious diseases and the apparently obscure question of their first appearance on earth are not arguments against the germ theory of disease, but are in favor of it. Of course, if you ask the exact moment of the appearance of the first germ in the world, I cannot tell. Can any one tell when the first maple seed was sown?

CONTAGIOUS PLEURO PNEUMONIA.

In order to make my arguments on the cause and nature of contagious diseases in general of some practical value, allow me to say a few words in regard to some of them in particular, and to discuss especially certain points relating to their treatment in their relation to live stock commerce. Let us first consider contagious pleuro-pneumonia, this much-talked-of disease of cattle. I am fully aware that I am addressing an audience which counts in its midst men of superior intellect, of long and varied experience in life, who are in good faith and do not believe in the existence of that disease in this country, and

others who, perhaps, do not want to believe. There are so many prejudices in my way that I cannot help but feel a great deal of delicacy in approaching the subject. Indeed, so many unjust criticisms and false accusations are daily thrown at those who are untiring in their efforts to cope with the plague that I feel as it I stood here a single soldier to guard and defend a fort attacked by a powerful enemy. When I consider such mighty influence brought to bear against the teachings which have time and again proved logical and just, and compare it with the little weight of my voice and the slightness of my enlightenment, I feel that the task before me is worthy of a mind of greater power and of language of more eloquence. But believing that it is the duty of every man to do all in his power to expose the injurious errors sustained in this world, and considering it in my double duty on this occasion, I will march forward to the battle and will endeavor to defend the fort of science with the weapons of truth, and truth must conquer sooner or later.

The outbreak of pleuro-pneumonia in Chicago has intensified in the minds of the people interested, the great anxiety which was felt all over the country on account of the ultimate result of this affection. What is pleuro-pneumonia? A description of it would seem useless since it has so frequently been given in the last years. Yet perhaps I may be better understood in giving again a few words of explanation. The lungs are made up of numerous tubes called bronchials, subdivided into innumerable little branches ending in little cells called air vesicles. The aggregation of a certain number of those vesicles forms what is called a lobule, and finally the union of the lobules with one another by the means of certain connective tissue forms the parenchyma or tissue proper—the lung as it appears to us. The tissue connecting the lobules is named interlobular conjunctive tissue. It is very abundant in cattle. Around the lobules may be found numerous little semi-closed sacs communicating with one another; they are the perilobular lymphatic sacs and vessels which have for their object to carry a whitish fluid known as lymph. Nerves and a net work of blood vessels—arteries and veins—all through the lungs, about complete the organization. The lungs are covered by a thin delicate membrane called pleura, adhering to them by conjunctive tissue also. The covering is so arranged that it forms two sacs, resting on each other in the center, and covering each lung by reflexion of this outer surface on one side, and lining the ribs of the other side by the same means. Thus in each side of the chest, between the lungs and corresponding ribs, there is a closed cavity formed by each sac, and the lungs are outside. They are named pleural cavities. You see then that there are, in the struc-

ture of the lungs as they appear to us when we open the chest, seven principal different parts almost independent of one another, so to speak. Their respective object is for the bronchial tubes to admit the air; the air vesicles to bring it in contact with the blood in the vessels passing in their delicate wall; the conjunctive tissue to connect the vesicles and lobules together, and shape the lungs; the nerves to preside over their action, etc.; the lymphatics around the air vesicles and lobules (among the loose conjunctive tissue, etc.) to carry the lymph called white blood, taken here and there in the system; the arteries and veins to take to and from the lungs the nourishing blood of the organ itself, and the black impure blood of the whole body, where it comes, to be purified in contact with the air in the air vesicles, whence it is returned to the heart after its purification and then forced in the intimity of the tissues for their nourishment; finally the pluera or coving of the lungs which secretes a serosity that prevents irritative friction of the lung tissue on the walls of the chest.

A HEALTHY LUNG

of cattle is of a pink color and soft spongy nature. Now there is truly only one disease which may be mistaken for true contagious pleuro-pneumonia; it is the ordinary pleuro-pneumonia, whether complicated of bronchitis or not, an affection uncommon in cattle. Bronchitis is the name given to the inflammation of the bronchial tubes—or air tubes—above their smallest divisions. It is characterized at first by the dessication of the mucous membrane covering the inside of the tubes. This dessication is followed by thickening of that membrane and then exudation of matter called catarrhal flow, which is thrown off by cough. Simple bronchitis never causes solidfication of the lungs, and therefore can never be diagnosed as contagious pleuro-pneumonia. Even in case where the disease is due the presence of worms in the tubes, such as parasitic bronchitis in calves, we never find lesions truly similar to those of the plague.

But when the simple inflammation of the bronchial tubes extends deeper into their smallest ramifications, until it reaches the air vesicles themselves and attacks them, it is then broncho-pneumonia. In this case, like in cases of simple pneumonia—which does not differ except that the air vesicles are imflammed primarialy without the bronchial tubes being so affected—an exudation takes place within the air vesicles themselves, they soon become filled up and more resisting to the touch, and finally the continual clogging succeeds in making a uniform solid mass of a portion or perhaps of nearly the entire substance of

one, and sometimes of both lungs. This solidifiacation of the spongy lung tissue is called haptization. Thus we understand that in those cases of inflammation of the lungs the solidification is due to the products of the inflammation of the air vesicles chiefly. We may occasionaly also see deposits of matter in the loose conjunctive tissue between the lobules, but it is chiefly due it seems to the oozing out of the watery or fibrinous substance of the blood, caused by the pressure of the swelling on the blood vessels. Those exudations outside of air vesicles may cause to a certain extent the formation of whitish bands like in contagious pleuro-pneumonia. The infiltration may extend even all over the lung under its covering, the pleura, and thus cause a marbled appearance, and finally the pleura itself may become gradually inflamed, and an exudation take place within its cavity. We have then before us a lung or lungs which are solid, more or less streaked with whitish bands, and we have an inflamed pleura with liquid in its cavity. And yet it is not contagious pleuro-pneumonia. Note here that solidification of a lung of cattle in ordinary pneumonia in advanced stage is of more or less uniform deep red or brown color.

Now what is the difference to be found in contagious pleuro-pneumonia? It is true, gentlemen, that to most observers the exact differential line may be unnoticed. In fact it is not always very clear even to the expert. Yet there are some points characteristic and peculiar to either disease.

In contagious pleuro-pneumonia the air vesicles, etc., forming the tissue proper of

THE LUNGS ARE GREATLY CONGESTED.

This congestion may take place in various portions of the same lung, at the same or different times, and thus cause it to be swelled and solid in various places independent of each other. It is not at first an inflammation of one single portion gradually gaining ground and thus forming a uniform solidification. These congestioned spots being of more or less recent dates, present to view various colors from light pink to deep red and dark brown, constituting the mottled appearance characteristic of certain stages. Each congested portion, however, may gradually extend around itself, or new congestive portions make their appearance between them, and finally all meet to form in the end one individual mass. In the mean time, there is, besides inflammation of the interlobular conjunctive tissue going on, and a seemingly greater inflammation of the perilobular lymphatic sacs. The inflammation of these lymphatics, which is an essential point in contagious pleuro-pneumonia causes the abnormal and enormous secretion of lymph distending them in the interlobular conjunctive tissue. This secretion,

increased probably by the production due to the inflammation of the conjunctive tissue itself, and perhaps also by a fibrous exudation from the blood interfered in its circulation, causes the formation of the thick whitish bands circumscribing each lobule, and the more delicate ones surrounding the air vesicles, as we find them in affected portions of lungs in an advanced stage in acute cases—a condition which gives to the surface of a cross section of such a lung, the appearance of a checkered board, or of irregular polygons. This is well appreciated on account of these clearly defined broad yellowish or whitish resistant bands formed in the conjunctive tissue and lymphatics surrounding the congestioned and solidified lobules which are of a pronounced color. Thus the exudations in this place are not chiefly within the cavity of the air vesicles, but it is besides, and principally, in the lymphatics and the conjunctive tissues. This is a characteristic point. This double if not tripple abnormal secretion causes an enormous distention of the lungs; they sometimes reach the weight of thirty or forty pounds, and it is said even more. We see then that the chief characteristic and peculiar lesions of the lung plague in a diagnostic stage, are the extensive congestion which may exist in various and separate parts at first, and

THE CONSEQUENT MOTTLED APPEARANCE.

The inflammation of the lymphatics and conjunctive tissue followed by a very extensive exudation of lymph and other fluids, thus forming thick whitish or yellowish bands surrounding red or brown polygons; the enormous distention of the lungs by the secretions combined, and the checkered appearance of the surface of a cross section. Besides that the inflammation extends to the pleura, thickens it extremely, causes it to secrete to a very great extent a liquid substance which may organize itself and form thick resistant yellowish flakes which may float in the chest and form adhesions between the pleura of the ribs and the lungs. If only one lung is affected there may be no liquid in the opposite side of the chest, because in cattle the pleural sacs of each lung are not in communication.

If at first sight we do not perceive a very great difference between the contagious and the ordinary form of pneumonia, we must not blindly jump to the conclusion that they are the same, for we must remember first that both are inflammations of the same organs, and that consequently some similar lesions cannot but occur. If we consider the intimate nature of the lesions and remember their entirely different cause, we will be led to a different conclusion.

Now, gentlemen, the animals dying at Chicago from the effects of lung troubles present not only the external signs of contagious pleuro-pneumonia, which are not very diagnostic, but in opening their chest

we find the general physical appearances and the lesions of the ravages of the disease. The pleura contains the fluid and flakes of the contagious malady, the lungs have the enormous size, and in cutting them we find that they present truly the minute lesions above described as being characteristic of the diseaae. What are they dying of? Some say it is nothing but consumption. I do not deny that the strength and health are being consumed by the effects of a lung disease, but if by consumption you mean tuberculosis, as it is generally the case among all men, you are entirely mistaken. There is not a symptom or lesion of true resemblance between true tuberculosis and contgaious pleuro-pneumonia. Never do we find in the lungs in this malady the characteristic tubercules that we find in the lungs and other places in consumption, unless the two diseases exist at the same time.

On the other hand what advantage is gained by terming the disease at Chicago consumption or tuberculosis? Are you aware that it is also a contagious disease of insidious nature, which is bound to kill its victims sooner or later? Are you aware that tuberculosis is not only transmissible from animal to animal, but from man to animal and animal to man? Are you aware that by drinking the milk from a cow having tubercules in the udder, man may get consumption and die? Perhaps some will ridicule this statement, so skeptical and unwilling are they to believe anything they can not readily comprehend. Yet it is a fact, an established fact, that consumption in cattle is transmissable to man.

THE PEOPLE OF AUSTRALIA,

and particularly of Melbourne City, becoming alarmed at the increasing number of cases of consumption and its destructive effects in their midst, named a commission in 1883 or 1884, to institute a search for the cause of the disease. It was composed of able physicians, veterinarians and stockmen, who labored conscientiously for two years. What was the result? It was to exclude from the butchers' shops and dairies all cattle affected with tuberculosis or consumption to a certain extent. Severe inspection of meat, dairy cattle, and milk, were recommended and adopted by Melbourne City for the prevention of the spread of tuberculosis among its citizens. What does all that teach us? It teaches us that consumption is a fatal malady which on account of its being transmissible from animal to man, is still more to be dreaded in a certain sense than contagious pleuro-pneumonia itself, which attacks cattle only. Therefore, gentlemen, if the name contagious pleuro-pneumonia sounds too hard for the disease affecting the cattle at Chicago, do not give it a name which justly gives terror to mankind.

Call it whatever may suit your condition or notion better, call it whatever may sound milder to your ears, but call it not consumption.

What is in a name? The disease would not be any less fatal under any other title.

If the disease I have seen at Chicago is not the true contagious pleuro-pneumonia, there is but one solution to the problem. It is that there must exists in this country a disease of the lungs which has exactly the same appearance and lesions, so far as we can judge, as contagious pleuro-pneumonia itself, and is due to something else than contagion. Is this probable? Is it possible? Is it logical to believe it? So long as observations, experiments and studies of the medical bodies of Europe and America have never found in centuries of labor anything tending to such a conclusion, we have no grounds for such a supposition. It is a fact that contagious pleuro-pneumonia is apparently more acute, more rapid, more fatal in some countries than others; it is a fact that in certain climates there seems to be more cases that pass to a chronic form and partially recover than in others; it is a fact that in certain seasons of the year it is more prevalent and more dangerous; that even in America it appears more rapid in its course and more destructive in some places than in others, although the death rate in general is given as being below that of most other countries, and that chronic cases seem more common here than in may parts of the European continent; but statistics on this disease are unreliable for many reasons, and besides all these peculiarities of occurrence, duration, intensity and fatality of the plague, which create doubt in our minds, are explained in a great measure by the fact that the germs may be weakened and destroyed by atmospheric influence of many kinds; that certain individuals, breeds of animals are better soils for their multiplication than others; and that certain conditions of the external world are more proper for their preservation, their multiplication, and their dissemination. No, I believe

WE ARE MAKING A MISTAKE

that may work harm, when we deny the existence of a destructive foe, and thereby protect it and nurse it in the very midst of the individuals it seeks to devour, simply because we fear it may scare the neighbors if we say anything about it. Let us acknowledge the truth so far as we know it, and if we are not satisfied, let us devise means to learn more. We are hungry for more knowledge, and wish to be undeceived, if we are deceived.

HOG CHOLERA, TEXAS FEVER, BLACK LEG.

Please have patience a little longer, and allow me to say a few words in regard to the nature of these diseases in general. I will only make a few general remarks. In fact, there is not much to be said on the matter, for neither of these diseases are as yet understood sufficiently to enable us to speak clearly on their character and prescribe any effective curative or preventive treatment.

There seems to be various fatal diseases of the hog which go under the name of hog cholera, and the most prevalent form in this country would be, according to Dr. Salmon, different to the French swine plague. The exact nature, or rather the differential points of those affections of our swine, and their relation with those of the same animals in the old world, are yet very obscure.

Texas fever, whose ravages we can appreciate, is yet looked upon as uncontrollable. Its mode of transmission, its symptoms, the lesions it presents are well known, yet the true nature of its germs are not determined in a manner to lead us to its extinction by any means.

Black leg, which kills calves by the thousand in every State, is still considered an unavoidable malady. Its relation with black leg in Europe, which is due to a parasitic vegetable is not proven.

Those three diseases which, in this country, cause through death far more damage than contagious pleuro-pneumonia by the same cause, seem to be received as a matter of course. True, a great deal is written about them, great would-be remedies and cure-alls are recommended, but it is a continual repetition of words of little practical value. We are really not much more advanced now in our knowledge of those maladies than we were fifty years ago, excepting that, judging from their contagious properties, we have every reason to believe that they are due to germs, and no reason whatever to believe the reverse.

Hog cholera is better understood in its intimate nature by a few—those who have had opportunities to study it more closely, for instance. The chief of the Bureau of Animal Industry, and some of his assistants. They expect to be able to prevent ere long what is known as hog cholera in this country. The reports I have seen to that effect are of a nature to make us truly hopeful. But since there seems to be a difference with this disease in this country and that which prevails in Europe, which is prevented by vaccination by Pastuer's methods, is it not possible that there exists more than one kind? In Germany they have discovered two forms of hog cholera—one is prevented by Pasteur's methods and the other is not—is it not possible to have the same thing here? Is it not even probable? What are we doing to find out the means of eradicating those maladies from the country, or at least the means of keeping them at bay?

WHERE IS THE MAN

in America who has the means and time to devote himself entirely to this study? Where is there an institution that has laboratories and financial means to conduct experiments in that direction, unless it be the Bureau of Animal Industry which is making noble efforts, but it is to the detriment of the country, overburdened with work of other nature? I know of none. We write, and write, and write. We repeat what scientists print in Europe; we try to establish connections with our cases in order to benefit our condition, but that is all, and it is of very little, if of any practical value. What are we waiting for? Are we waiting for finances? We have plenty—our country is wealthy. Are we waiting for proof of the existence of the maladies? It is childish to mention that. Are we waiting for the skies to clear out the virulent germs by an electric shock? No, no, we are waiting, I fear, for belief in science and confidence in scientific men. And so long as we will obstinately close our ears to the voice of those who sacrifice their life in the study of obscure problems by scientific methods, and greedily accept teachings of superstition and ignorance, so long shall we hinder the beginning of improvement in our condition.

Science is the only source from which means may be derived to fight successfully any contagious disease. Not only the treatment, but no measure, nay, no law, could have any truly practical value in this matter, were it not based on facts established by science. The most skilful statesman of the world could not enact a wise law for the prevention and eradication of a contagious disease without being well acquainted with its nature—and what can give him that knowledge, if not science? Why then should we remain so indifferent to its appeals, when we know it is the only plank of salvation? When I read in the American press comments and praises of scientific discoveries of Europeans, I always feel really pained. It sounds to me like the American people looked upon Europeans as possessing superior intelligence in matters of science. What is the principal basis and secret of their success? It is the confidence of people in science, and the consequent harmony of the scientists with the government, which helps them by legislation and financial support. Men of worth, men adapted to scientific researches, are amply supplied with laboratories and every thing necessary to conduct experiments to useful ends. Not only do the governments help them by this means, but they also offer rewards for discoveries, while the people in many occasions do not hesitate to supply at their own cost what may be needed in particular circumstances to conduct special experiments until a solution is obtained. How far are we from the practice of such a policy! And yet

what country on earth has better advantages to accomplish more scientific researches of any kind, particularly in agriculture, stock breeding, and in the domain of contagious diseases, than this vast glorious country of ours? Every State in the union has at least an institution which could well afford to devote time and money to the study of scientific problems in the laboratory and otherwise. Our own State—the State of Missouri—with its grand University and

AGRICULTURAL COLLEGE,

offers most admirable advantages for similar labor. This was soon realized by the learned President of this great institution. And it is with much pride that we point to the Missouri State University as one of the first of the kind in America to recognize the value of the study of contagious diseases of live stock and veterinary science in general, in establishing courses of study of comparative medicines in connection with its agricultural and medical departments; and the very first I think in inaugurating a vaccine and experimental laboratory. Such steps taken at the instigation of a man of the knowledge and judgment of Dr. S. S. Laws, and approved by the Board of Curators of the University, are worthy of serious consideration by all interested in agriculture and live stock, and by all the citizens of the State of Missouri in particular.

The inauguration of this laboratory for the study of contagious diseases was purely in the interest of the State and stockmen, and it was done with the hope that the people directly interested would soon understand and appreciate our motives and lend us financial assistance. We pray for nothing for ourselves personally, but for means to work entirely for your benefit, in studying the diseases of live stock, and conducting experiments with a view of finding preventives or curative remedies. In France the liberal assistance of the people to scientific workers has been rewarded by the discovery of successful vaccines for no less than four or five contagious diseases, which previously depopulated their farms and drove breeders and farmers to the wall. Why should we not expect as much in this country? Give us the necessary materials and time and we are ready for work. Millions and millions of dollars are lost annually by the ravages of diseases which, judging from other contagious affections of about similar nature, and judging from general principles, may sooner or later be prevented by vaccination, or other preventives to be found. How long will we defer the work? Who will enlighten us on the contagious diseases of man and beast in our own country if not ourselves? I repeat what I said on this subject on another occasion, help us all you who are able, help us for your own sakes, and we promise our life to you interest.

TREATMENT, LEGISLATION AND SANITARY MATTERS.

The medical treatment of contagious maladies is not always satisfactory. In fact, for several ones it is entirely useless. We will not dwell on these points. We will dwell especially on the general treatment, in which enters hygiene, preventives and sanitary police. Hygiene by itself, *i. e.*, the application of the laws circulated to keep the various organs of the body in harmony and proper tone, are not sufficient to prevent the contagious maladies, but they are of greater assistance in preventing their spread, shortening the course of epidemics, moderating their violence and preventing complications. Therefore, in all outbreaks of contagious affections, cleanliness, pure air, proper temperature, healthy, nutritious food of easy digestion, pure water, medicinal beverages, rest, cleanliness of the skin, the cleaning of the buildings, etc., should be among the first rules to be put in practice. Sanitary police, which means the laws and regulations adopted by a country or state or community to foresee, prevent and stop the propagation of contagious diseases, the progress of epizootics, with a view to their eradication, is undoubtedly the most important part of the treatment. But it is also the most delicate one to enact wisely. In our country, where the domestic animal kingdom presents one of the greatest industries of the nation, where the live stock commerce necessitating distant transportation is very extensive, where importations and exportations are very numerous, we must, in legislating against contagious diseases, aim to protect our stock without placing any embargo on traffic. Regarding our importations, the legislation should be such that the relations with foreign countries may never become a source of danger for the health of our live stock; and as to our exportation, it should be such as to give confidence to other nations in our people, a guarantee that our live stock is well protected from transmissible maladies, thereby facilitating and favoring transactions with foreign markets. But above all, since our country might suffice to itself, and that consequently we might do well, and perhaps even prosper temporarily without the exportation or importation of live stock, we must be careful how we enact sanitary laws relating to the protection of the respective States and Territories of the Union. We should aim to protect each State equally, but

NEVER TO STOP INTERSTATE COMMERCE

entirely for long periods, nor to restrict it in such a way as to render it almost impossible. The result of such courses, like the sweeping interstate quarantine now enforced against Illinois because there is no

other means of protection, and of which we had a bitter example last year, are most injurious, and in certain circumstances are outrageous; for they utterly ruin private individuals who have not the means to stand by and wait a more favorable time for the sale of their stock or to sell them at so great a loss as that occasioned by the restrictions, whilst those who have a prosperous business are pulled down to the verge of bankruptcy. Such excessively detrimental regulations, which are in a measure the result of the very pardonable ignorance of legislators in matters of contagious disease on one hand, and the attempt of States to formulate separately laws which in their application affects the commerce of the whole Union on the other, should be done away with and be replaced by a wise national sanitary police system, unless every State has a sufficient force of sanitarians to admit at every point of entry animals coming from supposed infected States, and then I doubt if it would work well.

It seems to me that instead of the present system of State quarantine, if each State and Territory had the guarding of the health of their respective live stock and no power to interfere with the march of commerce by any regulations—this being left to a uniform national law—it would be more to our advantage. But on what basis should State laws and national laws be built? Gentlemen, I am not a lawyer, therefore I cannot speak from a legal point of view, but I will simply make suggestions based on little experience in contagious diseases and study on this particular subject.

First let us see about State sanitation. Each State in the Union should be so regulated that whenever a contagious disease occurred within its borders, the sanitary authorities would be immediately informed, and thus no delay take place to allow its spread. How can this be arrived at? By two means; one is by imposing severe penalty on the proprietor, manager or care-taker of any animal or herd of animals who would fail to inform immediately the authorities of the appearance of a disease of a contagious or infectious nature among his live stock, and the other is by paying the proprietor a damage, or certain per cent. of the value of any animal reported and found suffering from contagious maladies necessitating severe prolonged home quarantine, or slaughtering of the subjects. The former way is rather radical perhaps, and might result in frightening the proprietors, who would ask themselves whether they declared the disease early enough to avoid being prosecuted. But the latter would have, it seems to me, some beneficial results. It would be an encouragement for poor proprietors especially; it would be proving to them that the State, in protecting her interests at large, seeks and does protect every individual in par-

ticular, rich or poor. Indeed, both means might be adopted at the same time, and perhaps with more benefits still. Besides that, every man should be bound in the same way to declare the existence of contagious diseases in his neighborhood, so far as he knew.

After declaration of the proprietor of the supposed existence of a contagious disease, the authorities would take hold of the matter, make an inspection and enforce home quarantine or destroy the subjects according to the nature of the disease, compensating fairly the injured proprietor, as I have just said. Then a thorough disinfection should take place. Disinfection is the means by which virus of any contagious disease may be destroyed and rendered harmless. Many agents are employed for this purpose. The cheapest and most active and safe ones are the following:

HOT WATER, CARBOLIC ACID SOLUTIONS,

sulphurous gas, fumigations of chlore, quick lime, rapid dessication, ventilation, fire, exposure to extreme cold, washing, boiling, etc. Practice has proved us that certain disinfectants are better suited to destroy the germs of certain maladies than others, for there are some germs that resist a very hot temperature, dessication, etc. Disinfecting agents act mechanically or chemically in various ways, too numerous to enumerate and explain here. Disinfection should be practiced long enough to destroy surely all the virus, or else it would be deception. It should be a severe offense, punishable by heavy penalty, to sell or trade any animal affected with a disease which has proved to be apparently transmissible, or to use in the public highways or anywhere within a hundred yards or more of any other animal any subject placed in quarantine by authority.

All carcasses of animals having died from contagious diseases should be buried or burned, or destroyed with quick lime or by other means, according to the nature of the virus.

This covers about the most important points of State sanitation, leaving out of course all the details. Could it be made practical with present force of sanitary officers of respective States and Territories? I doubt it. It would probably require more complete boards of health or live stock commissions, composed of physicians, veterinarians and stockmen, who would work in harmony. This composition of a sanitary bureau would, I think, be proper, for disease of beast frequently means disease of man, and besides, people of all professions and stages in life are more or less directly interested in the matter.

In cases of diseases which by their nature or the activity of commerce in the species of animals affected threaten to spread from State

to State, it woufd be the duty of the State sanitary officers to report to the national sanitary police office.

Now what about the foundation of this national sanitary police system? This would have for chief object to prevent the spread of contagious diseases from State to State, to stamp them out from where they exist and to prevent their introduction from foreign countries, by wise, just, but rigorous laws, giving at the same time confidence to foreign nations that our exportations are as free as can be expected from the germs of contagious disease of any kind. In order to stamp out and prevent the propagation of disease in the country, it should provide sufficient means to destroy on the spot all subjects found affected with a disease incurable or too disastrous, and which has a tentendency to spread, and to establish around the suspected localities a line of quarantine and prescribe proper treatment right then and there at the expense of the country, and with fair remuneration to the proprietors. You may say it would take an awful pile of money. But do not those cumbersome interstate quarantines which now exist and bob out at every report of contagious disease cause annual losses of thousands if not millions of dollars to the western country alone, to say nothing of the other parts? The whole system of a national live stock sanitary police could be sustained with less annual expense than the annual loss sustained by a few unfortunate States of the union alone through the effects of one single disease and its consequence on commerce—I mean contagious pleuro-pneumonia. Is not this point worthy of consideration? This national law

SHOULD ENFORCE DISINFECTION OF CARS.

We know the suitable places for the preservation and multiplication of disease germs—filthy cars are among them. There is perhaps no better means of transporting the germs of hog cholera, Texas fever and perhaps even pleuro-pneumonia and glanders than by the uncleaned cars, and I dare say that many apparently mysterious outbreaks of contagious diseases throughout the land might be traced to articles which had served in transportation—cars, ships and their necessary appliances, etc.

The cost of disinfecting cars and ships, if sustained by the companies, would not be as much as they now sustain by the restrictions of present State laws. And this rule would greatly diminish the spread of germs and the frequent outbreaks of disease which occur in stock yards in railway centers, and which have such a harmful effect on our live stock sales and transportation. Every State with stock yards

should have in readiness a separate place divided into two parts at least, where diseased and suspected stock should be at once taken without the least direct or indirect intercourse with healthy animals in the yards or outside, and without passing over or near the grounds of the yards. One of the divisions of such a place would serve for the suspected live stock and the other for the diseased. Both places to be kept clean and regularly disinfected.

The national sanitary police should have power to regulate importations of live stock in the country in order to prevent the introduction of contagious disease. This could be done by two different means. One by prohibiting the introduction of animals from countries where contagious diseases exist, unless it be in compliance with certain regulations, and the other to admit the animals at any time and from any country, excepting from countries where and during the time that epidemics exist, and to quarantine all imported stock of certain species for a definite period—a period a little longer than the period of incubation of the disease we aim to prevent. In Canada, for instance, they quarantine all imported cattle for a certain period whether healthy or unhealthy, and this year this wise system saved the dominion from the introduction of contagious pleuro-pneumonia and its consequent incalculable damage in a country. You are all aware that contagious pleuro-pneumonia broke out in Quebec at the quarantine station, and that all the animals were there destroyed and the disease spread no further, whereas that country would be fighting against it now in various parts as we are here if it had not been for that quarantine. Could not the United States, whose wealth and interest in the live stock is incomparably superior to that of the Canadians, great as it is, support several such quarantine stations? It is very little use to fight against contagious diseases in the interior if we have no means to prevent their reintroduction from foreign lands.

Thus the whole of our sanitary laws for the protection of our live stock would be composed of a national system looking after the sanitation of the whole country as above explained, and State regulations and sanitary police to keep healthfulness within their respective borders—the two systems to co-operate in harmony.

Naturally various details, in the difference and nature of the various contagious diseases of the country should be taken in consideration in framing such laws, but on general principles it seems to me that the suggestions could be made practical to a great extent—for instance, against contagious pleuro-pneumonia.

These laws should also take into consideration and favor, according to wise rules, the practice of experiments and the means of obser-

vations in order to test and determine the practical value of various treatments recommended against various contagious diseases—such as vaccination, inocculation, etc., which are successful in some other countries—and favor the devising of means to search for treatment and preventives for the contagious diseases apparently peculiar to our country.

FISH CULTURE, IN ITS RELATION TO AGRICULTURE IN MISSOURI.

An address delivered by Judge J. W. Emerson, member of the Board from Iron county, at a Farmer's meeting at Rolla, Marshfield and other places.

There is probably no other State in the Union whose climate, topography, and abundant water supply combine so many elements favorable to the successful culture of fish in artificial ponds and lakes, as the State of Missouri.

The enterprise of our State Fish Commission, and the wide distribution by it of food-fish not only to restock our partially depleted streams, but also to supply private ponds and lakes, have very greatly tended to awaken a wide and general interest amongst the people, and more especially amongst the farmers of our State. And yet, while this is true, the number of artificial ponds for the culture of fish is *infinitesimal* in comparison with the tens of thousands most desireable and available spots to be found in every neighborhood, lying unnoticed and worthless.

Indeed such spots are usually worse than worthless, or rather a nuisance on every farm where they exist unreclaimed, for the best places to make such ponds or lakelets will quite generally be in a bit of low land where there is a depression or basin forming a swale, grown up with willows, alders and water plants, a horror to look upon, and a terror to the farmer because of its capacity to mire his stock, as well as a covert for the pernicious "varmints" of the region around.

Again, the spot may be, as it most frequently is in Southern Missouri, where it receives the seepage from some spring; and a quarter of an acre to several acres will be a tough clay, with water oozing up everywhere just enough to form a sort of bog, and present anything of value from growing upon it; if in a meadow, the grass will be wild and

worthless, and because the spot is profitless, it is often allowed to have its own wild way, and soon present a shaggy bit of landscape barbarity from which the unlucky owner, and his bright boys turn their eyes whenever they are not obliged to look in that direction.

Moreover, as residences are usually located with reference to springs, the spots described will generally be near enough the residence to be an annoying blot on the fair face of nature until reclaimed, and at the same time close enough to be well protected when transformed into a shimmering lakelet.

There are thousands of farmers in Missouri who can turn their eyes from these pages, and look through their windows upon just such unpicturesque spots as above described.

But what are you going to do about it? I ask.

"What *can* I do about it?" one of the owners answers.

Let us see. Call the boys. Always take the boys into your counsels if you want help and encouragement in any new enterprise or improvement. They are bright fellows, and are sure to be on hand with a vim if a fish pond is to be made. Besides, it is on the boys the fish-pond must principally lean, so to speak, for care and protection, after it *is* made.

'Hello, boys! Come here! Give us a shake. Now my good fellows you like fish? like to catch them? all answer yes with a chorus, 'Well, why don't you dig out that horrid place down there and make it into a beautiful fish-pond—a bright little lake and have all the fish you want?' "By jimminiy," answer the boys, "lets do it; papa, can't we make a fish pond?" and fortwith it is agreed.

They suggest—"The harvest is ended, the wheat is sown, the month of October is the very time; no cash is to be spent; let us get help; change work with our neighbors, get extra teams, plows and scrapers and expedite matters; also will make a 'fish-pond bee'—why not? and all the boys around will come with teams and help, for they too will all want help to make fish ponds in a year or two—and the way we'll rattle out that miserable bog will be a sight to see." So the "old man" and boys answer in concert.

Arrangements are made to begin. Plows, scrapers, picks and shovels are about the only tools needed.

A small channel is cut, or pipe laid, to carry the water from the spring around the intended pond while the work of excavation progresses.

The boundaries of the pond are then marked out with reference to the surrounding undulations, to give it as nearly as possible such shape as nature would have given it in that place. If there should be

several inches of turf on the surface, it will pay to pile it here and there on adjacent fields, let it decay, then spread it as a fertilizer. There are many places where enough valuable fertilizer could thus be secured to pay for the work of excavating the entire pond.

Then plows and scrapers are put to work. The earth is deposited in all the low adjacent parts so as to make an even and lawn-like grade, a depth of four to six feet of water is secured in the deepest parts, care being taken to have good margin of shallow shore on the north side of the pond, where the warm rays of the springtime sun are sure to invite the fish to locate their spawning grounds, and for this purpose they like shallow water. Besides, the young fish need shallow water, where insect life (the principal food for fish) increases more rapidly than in deeper water.

Now, all hands have vigorously pushed the work of excavating and grading, and in two weeks the work is finished, and the water allowed to resume its old channel. The fresh excavation and grade for a hundred yards in all directions around the pond don't look inviting; but wait. Don't let the stock tramp it; let the frosts of winter apply their chemical processes; in the spring sow with oats and grass-seed, and in a year there will be a carpet of beautiful green.

A week later, and the farmer is aroused at early dawn by repeated bang! bang!! quite near, and he wonders if his premises can be attacked by robbers, he rushes to the window, looks out, and his eyes rest upon the little lakelet filled to brim with crystal water, shimmering under the first rays of morning light, a gladsome picture of beauty in place of the forbidding bog of former days; and on its surface floating, he sees a number of wild ducks, the victims of the watchful vigilence and sure aim of the boys. The wife is called, the other children come hurrying to the window, and all rejoice in the new beauty before them. All feel a new inspiration, and that this "thing of beauty" has revolutionized their entire surroundings.

One day the next spring a friend from town, who had a notion that clean and beautiful home surroundings are amongst the most potent factors in the civilization and elevation of mankind, came to see the fish-pond and advise about stocking it with fish. The farmer was out on the farm, but the boys and girls and "mama" gathered around the visitor in front of the house as they looked down a gentle slope to the pond, and marverlled at the change.

"Would they like to make it more beautiful?" he asked. "Oh, yes indeed, if that *could* be done," responded all.

"Shall I tell you just one or two things that can be done—only a few days work needed to make it very lovely"? "We'll try to do it if you will tell us," answered the boys.

"Very well; now observe," remarked the visitor, "how nicely the land slopes down to the water, but the space is taken up by stock-lots, some briars and weeds. I see the calves and small pigs, and geese and ducks come in the yard around the house. You can't have nice clean grass where they frequent. Now, suppose these fences are changed, and those lots put over that way to one side, and all this space from the house to the lake cleaned off, and made into a lawn, and the fence extended around the other sides of the lake or pond two or three rods from its margin, all made tight, and keep this space for "white folks"—men, women, girls and boys—exclusively, and make the animals and geese and *things* live by themselves; they can't be much civilized or benefitted by living in the company of white people anyhow.

Then you plant a lot of trees around the lake and all along the walk up to the house, sow plenty of grass-seed, keep all animals and geese and ducks out, and make it your own exclusive play-ground and possession. Don't let them come on your yard or ground any more than you would go and play in a goose lot or a pig sty. 'A time and place for everything.' Yes, but the place for pigs and calves and geese and ducks, *et cetera*, is not with white folks. All this would make your home very beautiful, and would greatly help to elevate the taste of the young folks, don't you think it would"? and the speaker turned to the farmer's wife, who said, husband and she often spoke of the importance of keeping animals, geese and ducks out of the yard, and it must be done. The other improvements would be so desirable, if only they could be made. "Jimminy," interrupted the elder of the two boys who were attentive listeners, "we'll do it, we'll get papa to let us do it."

Two years later there was, to be seen, a beautiful lawn from the house to the water, covered by a carpet of thick blue grass, clean, dotted here and there with trees, the fences around the house and lawn were whitewashed, and patches of roses and flowers were blooming, and the whole aspect of that home had been transformed from rough, unkept surroundings, depressing in their effect upon the sentiment of every member of the household, to that of refinement, culture, elevated taste and elevated thought. And not a dollar in cash had been paid out.

But all this the sober reader may think imaginary. Do not be too sure of that. If I were at liberty to particularize, you might think otherwise.

But let us for a few moments speak in a more matter of fact way.

There will be no dissent from the proposition that a supply of fish-food is a *very important* and *desirable* thing to every family in the

land. No farmer, and few others, would be content without raising a supply of poultry. He *could* get on, in a way, without it. But certainly such "getting on" would not be commendable. He *can* "get on" without raising a supply of fish, but would not a constant supply be as desirable and as valuable to any family as poultry? A moment's reflection will convince you, *Yes*. After the pond is made, the growing of fish will cost less trouble and labor than poultry.

PONDS.

The safest pond is that which is wholly excavated, for then there is no dam to leak or break.

The disadvantage of such a pond is that it cannot be drained to catch fish or remove objectionable fish from it. Where ponds are made by the erection of dams, it is not usually important to excavate any more than may be necessary to supply material for the dam, and in this case the shape and size of the pond will depend entirely upon the height of the dam and the conformation of natural banks, while the excavated lakelet or pond may be often located and shaped quite largely at the maker's pleasure, at least where water and topography will allow.

Ponds should never be made with steep banks, fish will not thrive so well in them. At least half of every pond should be quite shallow, say from two inches to two feet; the remainder, various depths, running to not less than five and not over ten feet. At least while a greater depth than ten feet would do no harm, it would be of no advantage whatever in this climate. If there are any natural bars or ridges running out into the pond, leave them there. If covered a foot to eighteen inches with water the fish will enjoy them on sunny days.

Don't try to get your shores or banks even or straight, or on set curves. Imitate nature in this regard. If you give attention to this, you will find that after you have nicely graded off and shaped the banks so there can be no abrasion or caving, and when you have planted shade trees and secured grassy banks where you can wander and enjoy the movements of the fish, and a few willows shall be planted here and there on the margin, the pond will lose its artificial appearance almost entirely. Of course you will provide ample shade for your pond as soon as possible. Fish need shade more than animals do. Until trees grow, put in a few rafts made of plank, poles or fence rails nailed together, and fastened to stakes securely driven, for shades for your fish. Make them so they will not be unsightly. Keep an eye always to the enhancing the beauty of the spot. Put in a few logs, so

arranged as to lie just under the surface of the water, held down by rocks so arranged that the fish can pass under them. A log is not a beautiful thing to be floating about.

I now and then see small ponds, so called, dug in the form of square pits, the banks quite vertical, exposed to the blazing sun the day long. You might as well expect a man and children to thrive in prison cells, as to hope to have fish live and thrive in such a place. Do not vex yourself with a trial in that way. Fish want a decent place to live, as do cattle, or human beings, if you expect them to live, thrive, behave decently and be happy.

FOOD FOR FISH.

Any body of water will furnish natural food for only a given number of fish, just as any field will furnish natural pasturage for only a given number of cattle. If you furnish enough artificial food, you may have the water as thick with fish as you could in the same way have your field swarming with pigs or cattle. Boiled cracked corn and boiled potatoes, (and where you have carp, vegetable trimmings,) are about the only items of food cheap enough to allow of use, hence I shall not suggest other articles which are occasionally used without reference to expense.

DAMS.

Of course each dam must depend upon its own situation. You cannot use a large stream for the private culture of fish, for, in the first place, you could not control the stream, and in the second place, you could not control the fish in it. Even very small streams, subject to rapid rise and freshets, cannot be used. The pond must be located where it is secure from overflow else the fish will escape, and your dam would often be ruined.

All the surface earth should be scraped away for the foundation of the dam, and the surface earth from the pond should not be used in the body of the dam—only hard earth should be so used. If your dam is four feet high, do not make its base less than thirty to forty feet wide, sloping both ways to a width of ten to fifteen feet on top.

Such a dam, if well tramped by the teams in the making, is likely to stand a lifetime if not exposed to violent freshets. It is safer to cut an outlet around the end of the dam, through the natural formation, than to allow the surplus water to pass anywhere over the dam even in a pipe or slide. If you take it thus around the dam, you can carry it in the canal a good distance below and thus avoid the danger of abrasion.

A thin dam of earth is certain to become saturated and softened, and with the aid of the crawfish, is sure to go to pieces in a wet season. And such a disaster involves not only the cost of the dam, but the loss of your fish. Make it strong and safe in the beginning so that you can rest and sleep with composure through any storm.

OTHER DANGERS TO BE GUARDED AGAINST.

These arise mainly from minks, turtles, snakes, cranes, ducks, geese and the like. The boys must use their guns and fine shot freely, and they will keep away the pests quite largely. A pleasure boat kept on the water will cause the place to be less lonely, and will do much to frighten away enemies of the fish. On no account whatever allow your geese or ducks to occupy your fish-pond. It will not do. Besides, if you have the grounds nicely fitted up and neatly kept, you want them kept clean. If you raise fish you must have a different pond for your poultry.

Some of your fish may be stolen, not by enemies like the snake or turtle, but by human lovers of them. But what of it? You occasionally lose chickens from your hennery, but you do not therefore abandon the raising of poultry. And if we will multiply private fish-ponds until the private culture and ownership of fish becomes as common and as well recognized as the private ownership of chickens, you will find that there will be no greater danger of the invasion of your fish-pond than of your chicken-house. Indeed, not so much, for there is little danger that any of the varieties of fish which you would care to cultivate could be caught at night to any extent.

KINDS OF FISH.

I have space to add but few words as to the best kinds to be raised in ponds. If your pond embraces as much as two or three acres, and the water is cool and good, you can venture bass, croppie, and two or three of the best varieties of the perch family. If not over an acre I would advise omitting the bass as they are specially destructive.

If the water is stagnant, or warm, or muddy, or has a tendency that way, by all means stock it with carp. They are inferior in quality to the native fish named, but are hardy, vigorous growers, and in any water will produce double the quantity of fish food of any other fish I know. They are supplied without cost by our State Fish Commission, Dr. L. G. W. Steedman, President, Pine Street, St. Louis.

CONCLUSION.

I look forward to the time when fish ponds teeming with an abundant supply of the best of fish, with boats and beautifully ornamented grounds for pleasure, will be the possession and treasure of tens of thousands of the farmers of Missouri, adding their blessings, their pleasure and contentment to country life, and presenting one of the most attractive and elevating features of modern economic and social life and civilization.

ADDRESSES OF CORRESPONDENTS.

The following names are those of gentlemen who have kindly furnished this office with the data upon which the monthly crop reports issued from this office are founded. If those in the various counties, into whose hands these names fall, will forward me the name of a competent farmer in any township of the county, not represented, the Board of Agriculture will be thankful for the receipt of the same. These names are published partly in response to calls for them, also in expectation of receiving additional names, where needed, and to give the public, for whom the work is done, some evidence of the character of its source of information:

ADAIR.

Jos. M. Moore, Brashear.
J. J. Clark, Sublette.
Jno. Shibley Shibley's Point.
W. R. Hopkins, Brashear.
Noah Stukey, Millard.
Jacob Sands, Kirksville.
A. Kinyon, Novinger.
S. R Dunham, Brashear.
Judge Jno. S. Porter, Kirksville.

ANDREW.

S. K. Faulkner, Whitesville.
Newton Bird, Avenue City.
Isaac Selecman, Savannah.
G. L. Gore, Savannah.
Benj. Petree, Fillmore.
Jno. F. Mead, Savannah.
J. W. Laney, Rosendale.
W. P. Hayzlett, Bolckow.
T. F. Kent, Avenue City.

ATCHISON.

W. J. McMillan, Blanchard, Iowa.
R. Buckham, Langdon.
James Law, Magnet
Stephen South, Watson.
J A. Hoon, Watson.
W. L. Belding, Magnet.
Wilson Gray, Tarkio.
T. F. Bennett, Tarkio.

AUDRAIN.

L. S. Hopkins, Mexico.
R. N. West, Mexico.
R. T. Steele, Wellsville, Montgomery Co.
D. M. Hill, Mexico.
S. C. Hale, Laddonia.
G. W. Batterton, Sturgeon.
Henry Detienne, Mt. Carmel
L. H. Hightshol, Mexico.
E. C. Waters, Vandalia.

BARRY.

H. S. Montgomery, Washburne.
M. H. Roberts, Golden.
J. M. Lambert, Rocky Comfort.
Peter McNally, Exeter.
J. W. Garley, Purdy.
Jno. Ray, Cassville.
T. P. Withers, Peirce City, Lawrence, Co.
A. M. Wiley, Scholton.
James Avonee, Peirce City.
James N. McNeely, Purdy.
W. A. Boucher, Exeter.

BARTON.

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G. M. Wikoff, Sheldon, Vernon Co.
J. S. Long, Lamar.
Dr. Owen Blacker, Dublin.
William R. Harbur, Summit.
F. A. Jones, Le Roy.
C. Pierce, Irwin.
B. F. Miles, Nashville.
Hon. D. T. McGown, Golden City.
Add. Baker, Lamar

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H. O. Haynes, Rockville.
A. E. Page, Appleton City.
A. B. Wilkins, Sprague.
J. D. H. Butler, Lone Oak.
H. Philbrick, Rich Hill.
Henderson Miller, Foster.
A. J. Smith, Adrian.
Jas. Burrows, Mulberry.

BENTON.

J. R. Caldwell, Ft. Lyon.
David Brier, Lincoln.
W. F. Joplin, Lincoln.
Henry Fristoo, Palo Pinto.
J. L Feaster, Fairfield.
Henry Mahukin, Cole Camp,
William B. Ham, Warsaw.
L. B. Lankford, Fairfield.
Joel Owen, Mt. View.

BOLLINGER.

Geo. W. Harrington, Marble Hill.
H. J. Murray, Sedgewickville.
W. H. Williams, Mayfield.
John C. Conrad, Patton.
J. J. Conrad, Marble Hill.
H. J. Shetley, Castor.
Jas. G. Woodfin, Shepperville.
J. M. Tallen, Marquand.
Peter Stiltz, Bollinger's Mill.

BOONE.

W. Feely, Wilton.
O. B. Thomas, Ashland.
W. W. Jennings, Centralia.
W. L. Parker, Columbia.
W. C. Vanausdal, Claysville.
Smith Wilhite, Perche.
Geo. M. Pipes, Rocheport.
F. W. Smith, Columbia.
M. V. Jennings, Centralia.

BUCHANAN.

Dr. C. R. Woodson, St. Joseph.
W. S. Wells, Rushville.
A. F. Greenard, Garrettsburg.
Wm. Matney, Platte River.
F. M. James, Easton.
John Chestnut, Wallace.
Jas. E. Weller, Stanley.
Eugene Spratt, Wallace.

BUTLER.

Jas. F. Tubb, Poplar Bluff.
John Endaly, Shiloh.
John Roberts, Neelysville.
John Bumgardner, Poplar Bluff.
J. L. Garretson, Harviel.
J. E. Estes, Hendrickson,
A. Kelley, Qulin.
J. L. Battington, Poplar Bluff.
E. Davidson, Ash Hill.

CALDWELL.

L. C. Jones, Catawba.
Wm. Smiley, Hamilton.
Parker Platt, Mirabile.
D. C. Wells, Catawba.
Rev. D. W. Monroe, Kidder.
Jno. Sigman, Hamilton.
C. M. Kendall, Hamilton.
T. P. Allen, Kidder.
Jno. McManigal, Kidder.

CALLAWAY.

Jno. L. Erwin, Fulton.
Dr. Tarlton, Cedar City.
N. G. Caldwell, Caldwell.
P. B. Gingrich, Fulton.
Lee W. Rood, Williamsburg.
R. D. Rood, Williamsburg.
David Newsom, Caldwell.
Jno. D. Jolly, Millersburg.
R. O. Humphreys, Guthrie.
Wm. A. Douglass, Martinsburg, Audrain County.

CAMDEN.

Geo. J. Moulder, Mack's Creek.
J. L. Claiborne, Decaturville.
V. Bowers, Decaturville.
Silas W. Crocker, Climax.
W. F. Claiborne, Decaturville.
W. F. Simpson, Climax.
G. C. Thornton, Linn Creek.
G. C. Thornton, Cape Galena.
T. H. B. Moulder, Cave Pump.
J. M. Ayers, Climax.

CAPE GIRARDEAU.

W. E. Lang, Appleton.
J. J. Sawyer, Pocahontas.
Amos Link, Millerville.
W. A. Ranney, Cape Girardeau.
L. M. Bean, Gordonville.
D. R. Cowan, Millerville.
H. Bruihl, Oak Ridge.
W. G. Schneider, Dutchtown.
J. S. Henry, Gravel Hill.
Samuel Hitt, Cape Girardeau.

CARROLL.

E. B. Hitt, Roads.
Henry Diezel, Carrollton.
T. J. Brown, M. D., Bottsville.
Marian Shirley, Bogard.
Wm. Smithpeter, Mandeville.
F. B. Wrockloff, De Witt.
L. E. Dorsey, Norborne.
W. A. Hatcher, Norborne.
Warren Mayfield, Roads.

CARTER.

A. J. Patterson, Lee.
John McSpaden, Jerome.
David L. Massie, Pike.
Nathan Massie, Pike.
F. M. Coleman, Jerome.
Jos. B. Stephens, Freeland.
Henry Harden, Leach.
John Heart, Pike.

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J. D. Eubank, Pleasant Hill.
W. L. Storms, Pleasant Hill.
Geo. E. Hudson, East Lynne.
G. M. Houston, Harrisonville.
John Etter, Archie.
Nelson McCormack, West Line.
T. P. Shadowens, Austin.
M. H. Berry, Lone Tree.

CEDAR.

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J. W. May, Virgil City.
T. P. Moore, Jr., Caplinger's Mills.
C. N. Jordan, Jerico.
J. B. Warren, Eldorado Springs.
G. L. Walker, Stockton.
R. R. Harris, Meadow.
W. R. Williams, Humansville.
J. N. Cox, Stockton.
J. W. D. Kirkpatrick, Stockton.

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Jno. Bayne, Hamden.
G. W. Stowe, Rothville.
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James Saunderson, Malcolm.
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J. J. Brown, Ozark.
Sam'l M. Cracken, Sparta.
C. C. Cowan, Kenton.
J. B. Fowler, Sparta.
B. Nicholas, Highlandville.
W. J. Wray, Ozark.
G. B. Nichols, Finley.
T. D. Miller, Rogersville.
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John W. Llewellyn, Winchester.
Jno. Riley, Anson.
Hosea Stout, Winchester.
Leonard Ford, Williamstown.
Jas. Stafford, Fairmont.
E. L. Christa, Acosta.
Wm. McDermot, Kahoka.

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H. T. Simrall. Liberty.
W. H. Arnold, Kearney.
Jas. S. Robb, Liberty.
J. C. Evans, Harlem.
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A. B Crawford, Smithville.
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W L. Culver, Grayson.
James Williams, Cameron.
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George Ditmars, Turney.
S. D. Green, Converse.
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M. A. Dunlap, Centertown.
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J. A. Hunter, Russellville.
Elias Elston, Elston Station.
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William Murphy, Centertown.
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S. L. Jewett, Clark's Fork.
T. A Harris, Prairie Home.
D. F. Nixon, Harrison.
T. A. Bear, Boonville.
I. W. Hupp, Otterville.
Thomas Mellor, La Mine.

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Daniel W Turnure, Oak Hill.
T. N. Reeves, Leasburgh.
Larkin Gross, Sligo Furnace.
L. D. Grover, Cuba.
I. W. Cowden, Leasburgh.
W. J. Parker, Osage.
Albert Hamilton, Oak Hill.
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S. E. Shaw, Dadeville.
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P. R. Pidcock, King's Point.
C. J. Baldwin, Greenfield.
W. K. Morgan, Dadeville.
C. Z. Russell, Lockwood.
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G. A. Howerton, Long Lane.
T. S. Tinsley, Buffalo.
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Boon Bacon, Kidder, Caldwell Co.
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Abel Allen, Jr., Kidder, Caldwell Co.
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J. V. More, Haydensville.
H. C. Burnham, Fairport.
Daniel Pittman, Fairport.
L. Ensign, Cameron, Clinton Co.
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Frank Brown, Amity.

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Tim. Hickman, Montauk.
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A. P. Kerr, Salem.
Frank Moser, Salem.
Larkin Goss, Sligo Furnace.
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David Clodfeller, Buckhard.
George Ritterman, Heth.
W. H. Brown, Arno.
Aaron Clinton, Florilla.
Elihu Farmer, Cold Springs.
Henry Klineline, Ava.
J. F. Patterson, Heth.

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J. M. Douglass, Senath.
G. T. Smith, Cotton Plant.
E. J. Langdon, Cotton Plant.
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E. J. Roberts, Robertsville.
H. Calkins, Shotwell.
Samuel T. Baker, Sullivan.
John H. Schweer, Shotwell.
D. P. Wood, Gray's Summit.
John Schiller, Union.
August Altheida, New Haven.

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Fred Lincke, Bem.
Charles W. Mellies, Woollam.
T. J. McMillan, Bem.
Simon Boeger, Bay.
H. T. Aufder Heide, Bland.
W. H. Taylor, Bem.
Christian Auken, Fredericksburg.

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George W. Hadley, Gentryville.
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A. M. Butler, Ford.
Charles G. Comstock, Albany.
A. W. Darling, Stanberry.
S. W. Moreland, King City.
G. D. Burton, King City.
Dr. J. C. Farr, Alanthus Grove.

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A. P. Harwood, North Springfield.
A. J. Long, Fair Grove.
D. M. Evans, Ebenezer.
H. N. Moreland, Stafford.
James F. Brooks, Republic.
J. E. Bodenhamer, Henderson.
M. O. Bedell, Hickory Barren.
R. M. Hunt, Galloway.
F. J. Smith, Rogersville, Webstor Co.
W. H. Noe, Brookline.

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R. Brown, Buttsville.
George H. Hubbell, Trenton.
H. C. Crooks, Gault.
R. M. Cook, Lindley.
John Mears, Spickardsville.
John W. Shipman, Shipman.

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Dr. William D. Bryant, Cainesville.
J. H. McLey, Bolton.
Albert Reeves, Ridgeway.
Isaac M. Neff, Bolton.
Berges Baber, Blue Ridge.
L. P. Riley, Akron.
Nelson Church, Mt. Moriah.
William Bolar, Bethany.

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D. E. McBride, Garland.
I. M. Pretzinger, Clinton.
G. W. Goodlet, Windsor.
M. L. Stafford, Windsor.
James M. Honner, Montrose.
John H. Britts, Clinton.
J. P. Ozias, Clinton.
J. N. Newman, Lewis Station.
R. J. Eubant, Gaines.

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M. H. Cooper, Pittsburg.
James A. Brakebill, Cross Timbers.
M. N. Neihardt, Hermitage.
M. L. Kelly, Elkton.
S. B. Selby, Preston.
William H. Liggett, Wheatland.
W. L. McCusling, Wheatland.
J. M. Gentry, Quincy.

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Peter Dearmont, Mound City.
George Hibbaid, Oregon.
Judge G. P. Skeds, Mound City.
William Kaucher, Oregon.
N. F. Murray, Elm Grove.
B. O. Cowan, New Point.
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Dr J. M. Walker, Armstrong.
George M. Pipes, White's Store.
John O. Winn, Burton.
W. A. Settles, Fayette.
R. T. Kingsbury, Estill.
James R. Estill, Estill.
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E. C. Ferguson, Willow Springs.
Thomas M. Christian, Mountain View.
W. A. Hill, South Fork.
Robert S. Hogan, West Plains.
J. G. Henry, Hutton Valley.
P. N. Gully, Hutton Valley.
James Chestnut, Pottersville.
James Stein, Peace Valley.

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J. E. Lowe, Belleview.
A. C. Crocker, Goodland.
J. W. Lashley, Belleview.
T. P. Russell, Ironton.
Nute Simms, Berryman.
J. R. Adams, Goodland.
John S. Luthy, Edge Hill.
William Lyman, Pilot Knob.

JACKSON.

Capt. John A. Webb, Blue Springs.
Z. S. Ragan, Independence.
E. F. Jones, Lee's Summit.
S. C. Ragan, Hickman's Mills.
H. C. Chiles, Buckner.
J. A. Clements, Hickman's Mills.
J. A. Havron, Hickman's Mills.

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D. M. Whitworth, Webb City.
W. M. La Force, Carthage.
William Dick, Medoc.
John Dermott, Carthage.
W. H. Rusk, Sarcoxie.
J. A. Daugerty, Carterville.
R. A. Stephens, Reeds.
T. Malyreux, Oronogo.

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T. W. Guy, Kimmswick.
Veazey Price, House's Springs.
E. G. Funk, Danby.
W. S. Jewett, Crystal City.
William Bryan, Morse's Mills.
W. F. Holt, Danby.
Thompson Brown, Hillsboro.
Henry Funk, Danby.

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John J. Lee, Leeton.
S. J. Workman, Knob Noster.
W. B. Wallace, Kingsville.
J. A. Adams, Warrensburg.
Joseph P. Ozias, Centre View.
William Mohler, Warrensburg.
George Gibbs, Holden.
D. T. Boisseau, Pittsville.
Dr. I. B. McGirk, Chilhowee.

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Dexter Botts, Novelty.
W. M. Anderson, Plevna.
E. M. Randolph, Edina.
S. K. Fowler, Edina.
J. D. McFarland, Edina.
Joseph H. Blair, Newark.
Casper Futters, Greensburg.
I. J. Bittler, Locust Hill.
Jno. A. Swearingen, Sand Hill.

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John T. Quinn, Richland, Pulaski Co.
L. C. Detniler, Delto.
J. W. Smith, Conway.
I. W. Mayfield, Lebanon.
J. A. Pond, Pine Creek.
W. B. Clark, Lebanon.
Capt. Sam Turner, Conway.
I. N. Browning, Lebanon.
Chas. V. Taylor, Bradfield.
Webster Windsor, Lebanon.

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D. J. Waters, Corder.
B. F. Hammer, Wellington.
J. G. Webb, Corder.
Wm. T. Gammon, Odessa.
J. D. Robinson, Lexington.
Rufus Young, Lexington.
Henry Miller, Concordia.
C. T. Ford, Greenston.

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W. N. Gray, Marionville.
J. A. Cochran, Mt. Vernon.
Jos. B. Underwood, Phelps.
J. L. Wright, Peirce City.
Wm. Cochran, Mt. Vernon.
Jos. R. White, Verona.
J. N. Downing, Hall Town.
E. S. Allen, Mt. Vernon.

LEWIS.

S. M. Finley, La Grange.
A. M. Green, Canton.
Wm. H. LaRue, La Belle.
E. Morris, La Belle.
W. M. Travise, Bunker Hill.
Newton Childress, Canton.
R. Jones, Argola.
A. C. Levengood, Deer Ridge.
W. H. Wallace, Lewiston.

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H. B. Suddarth, Foley.
A. F. Downing, Auburn.
D. T. Killam, Winfield.
J. T. Nicklin, Elsberry.
Jas. M. McClellan, Troy.
Fred L. Jabin, Wright City, Warren Co.
Dr. W. D. Welch, Brussels.
Finley Wallace, Brussels.

LINN.

Jas. C. Slater, Linneus.
Jno. B. Carter, Orlinda.
B. B. Putnam, Bucklin.
Jno. T Goddard, New Boston.
C. W. Trumbo, Linneus.
W. H. Patterson, Meadville.
Jas. P. Withrow, Linneus.
Geo. W. Goldman, Brookfield.
Jno. Carter, Browning.
J. D. Rumwell, Laclede.

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Hon. W. A. Jacobs, Chillicothe.
Wm. Scruby, Jr., Wheeling.
Hon. Jno. Donovan, Wheeling.
R. Warren, Utica.
H. V. Lewis, Hale.
L. H. Christian, Spring Hill.
Lewis Boyle, Muddy Lane.
Jas. L. Boyle, Muddy Lane.
Jas. Hale, Sampsill.
Jno. T. Jackson, Sec'y, Chillicothe.

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Jos. Montgomery, Rocky Comfort.
R. B. Montgomery, Rocky Comfort.
W. T. Bailey, Rocky Comfort.
Jno. Bunch, Rocky Comfort.
Daniel Harmon, Erie.
Spencer Owsley, Bethpage.
R. W. Williams, Indian Springs.
Thomas Bailey, Rocky Comfort.
S. D. Preston, Southwest City.

MACON.

J. F. Brickell, Macon City.
F. M. Winn, Beverly.
James M. Love, Macon City.
G. Goodson, New Cambria.
C. W. McJilton, Atlanta.
L. P. Riley, Ettle.
W. A. Miles, Atlanta.
J. B. Thompson, La Plata.
J. B. Epperson, Jr., Maple.

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Jacob Lutes, Marquand.
G. W. Whitworth, Fredericktown.
J. M. Anthony, Fredericktown.
O. J. Brownfield, Madison.
Joseph Deguire, Fredericktown.
J. R. Turner, Fredericktown.
Jno. H. Townsend, Fredericktown.
Lee A. King, French Mills.
J. W. Tallent, Marquand.

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Lindon Marts, Grove Dale.
J. B. Johnson, Lacon.
J. H. Metabarger, Vancleve.
Hon. H. V. Warren, Vancleve.
M. Williams, Maries.
G. P. Skaggs, Vancleve.
Wm. Branson, Maries.
Hon. J. A. Love, High Gate.

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Jos. Adams, Benbow.
Daniel Boone, Jr., Ely Station.
D. C. Johnston, Benbow.
Jas. R. Dudley, Wither's Station.
Judge Henry C. Davis, Warren.
Hon. R. N. Sharp, Philadelphia.
David E. Wade, Hannibal.
Jos. W. Bennett, Palmyra.

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W. E. Peters, Pleasanton, Iowa.
O. H. Southworth, Half Rock.
J. A. Kennedy, Ravanna.
Wm. Speer, Princeton.
J. P. Drake, Ravanna.
B. F. Bushong, Goshen.
H R. Schoonover, Cleopatra.
A. B. Anderson, Ravanna.

MILLER.

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J. C. Tallman, Iberia.
Richard Boyce, Eldon.
J. A. Fisher, Ramsey.
W. M. Lumpkin, Aurora Springs.
H. C. Jackson, Ulman's Ridge.
Wm. M. Harrison, Mt. Pleasant.
W. H. Hauenstein. Tuscumbia.

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F. J. Hess, Wolf Island.
Jno. N. Michenor, East Prairie.
F. A. Jordan, Wolf Island.
Stephen Bird, Bird's Point.
Chas. F. Hurst, Bird's Point.
J. H. Guthrie, East Prairie.
Judge G. N. Hudson, Belmont.

MONITEAU.

Dr. Wm. Redmont, Tipton.
R. Q. Roache, California.
B. F. Bradford, High Point.
Geo. T. Clark, Clarksburg.
Jas. E. Bybee, California.
Loronzo Frost, Jamestown.
Judge H. C. Hickox, California.
Wm. H. Howard, Tipton.
W. C. Aldridge, California.

MONROE.

F. P. Vaughn, Paris.
W. Webb, Granville.
O. J. Brownfield, Madison.
M. A. Maupin, Middle Grove.
H. C. Baker, Madison.
W. S. Forsyth, Strother.
C. C. Wakefield, Monroe City.
C. M. Reed, Paris.
Porter Bush, Monroe City.
Edwin Bossett, Madison.

MONTGOMERY.

A. W. Hathaway, High Hill.
Chas. Walz, Big Spring.
E. M. Steere, Wellsville.
Herman Kallmeyer, New Florence.
Dr. Oscar Monnig, Americus.
F. H. Kallmeyer, New Florence.
G. H. Dunford, Montgomery.
G. H. Kallmeyer, Best Bottom.
Dr. Wyatt, Price's Branch.

MORGAN.

A. B. Brock, Barnett's.
L. J. Baughman, Florence.
C. C. Marriott, Stover.
Jeff. Parsons, Syracuse.
R. Sanburn, Search.
T. G. Snorgrass, Tipton, Moniteau Co.
J. H. Alfter, River View.
William Wendlecon, Akinsville.
G. C. Thornton, Cape Galena.
Thos. Y. Marriott, Gravois Mills.

NEW MADRID.

D. C. Pollock, New Madrid.
C. C. Thomas, Point Pleasant.
Wm. R. Fields, Portageville.
A. O. Allen, New Madrid.
Wm. Riley, New Madrid.
Conrad Leissler, Sikeston, Scott Co.
E. B. Mills, Sikeston, Scott Co.
Jas. Johnson, Sikeston, Scott Co.
J. M. Broughton, New Madrid.

NEWTON.

Geo. Hatzfield, Neosho.
J. W. Roseburry, Kent.
Jas. H. Dean, Seneca.
G. W. Weens, Newtonia.
T. H. B. Armstrong, Ritchey.
J. R. Smith, M. D., Kent.
Chas. W. McKinley, Grangeville.
Jasper Buzzard, Racine.
J. F. Holmes, Rocky Comfort, McDonald Co.

NODAWAY.

M. B. W. Harmon, Pickering.
B. L. Cook, Guilford.
John F. Bainum, Burlington Junction.
F. B. Dinsmore, Gaynor City.
Hon. A. P. Morehouse, Maryville.
M. Goodson, Sweet Home.
Judge M. Landfather, Barnard.
J. E. Reese, Maryville.
Jacob Winter, Clyde.

OREGON.

Capt. J. J. Sitton, Garfield.
A. G. Hall, Alton.
T. M. Simpson, Wilderness.
Jefferson Lance, Many Springs.
Benjamin Gum, Alton.
J. M. Hall, Jobe.
W. A. Fraley, Thayer.
W. N. Evans, Alton.
J. B. Powell, Alton.

OSAGE.

D. A. Waters, Boeger's Store.
B. C. Francis, Byron.
C. H Dallas, Chamois.
Chas. Boehm, Fenersville.
T. McCuin Cooper, Useful.
Joseph Albertson, Linnwood.
W. A. Ferruson, Chamois.
H. Gidinghagen, Linnwood.
W. F Cochran, Chamois.
Judge Schrader, Richfountain.

OZARK.

G. T. Price, St. Leger.
T. P. Sims, Gainsville.
W. T. Alexander, Udall.
Frank Bennett, Dora.
S. A. Beach, Almaratha.
S. C. Herndon, Almaratha.
B. V, Morris, Rock Bridge.
A. Humbird, Thornfield.

PEMISCOT.

Geo. W. Carleton, Gayoso.
A. C. Faust, Gayoso.
W. F. Pike, Cooter.
Thos. D. Curtner, Braggadocio.
H. C. Garrett, Cottonwood Point.
S. H. Dowd, Gayoso.
J. N. Denton, Covington.
W. A. Liggett, Fisher.
J. W. Morgan, Fisher.

PERRY.

R. M. Brewer, Brewersville.
Jos. G. Weinhold, Wittenberg.
Otho Price, Brazeau.
R L. Tucker, Silver Lake.
C. U. Prost, Perryville.
Jas. Rice, Bois Brule.
Henry Yount, Yount's Store.
W. S. McBride, Silver Lake.
J. M. Manning, St. Mary's.

PETTIS.

V. T. Chilton, Smithton.
G. W. Gregg, Hughesville.
J. L. Cartwright, Longwood.
A. H. Hanley, Longwood.
Jos. G. Gregg, Houstonia.
T. F. Houston, Houstonia.
Thos. Gregory, Longwood.
W. F. Joplin, Ionica City.
A. J. Hall, Lamonte.

PHELPS.

A. A. Newman, Rolla.
Geo. Smith, Edgar Springs.
E. K. Light, Newburg.
P. M. Gaddy, Arlington.
Alex. See, LeComa, Dent Co.
Jas. M. Dillon, St. James.
Dr. Jno. S. Frost, Rolla.
O. P. Paulsell, Rolla.
Wm. Dawson, St. James.
M. Goodwin, Rolla.

PIKE.

W. C. Downing, Bowling Green.
Wm. Pritchett, Frankford.
A. P. James, Elk Lick Springs.
C. B. Gillum, Ashley.
Valentine Tapley, Spencersburg.
Dr. H. B. Butts, Louisiana.
W. F. Oglesby, Clarksville.
J. D. Pitt, Frankford.
Moses A. Farmer, Farmer.
Marcus M. Wood, McCune Station.

PLATTE.

G. R. Arnold, Dearborn.
W. C. White, Parkville.
C. C. Graves, Weston.
Probasco Thomas, Tracy.
Jas. Wallace, East Leavenworth.
Jas. I. Gabbert, Weston.
G. A. Warners, Platte City.
J. H. Boydston, Edgerton.
J. S. Robertson, Parkville.

POLK.

H. M. Wollard, Dunnegan.
J. C. Smith, Fair Play.
Benj. F. Leonard, Bolivar.
Milton Brown, Rondo.
Dr. J. W. Farmer, Bolivar.
Silvester Mapes, Half Way.
Jno. Carson, Bolivar.
B. F. Teeter, Half Way.
P. Findley, Humansville.

PULASKI.

A. J. Colley, Richland.
D. A. Claiborne, Hancock.
J. H. Ross, Big Piney.
W. A. Faster, Richland.
M. O. Mitchell, Hancock.
M. W. Wright, Richland.
Olie B. Vaughan, Tribune.
D. B. Colley, De Bruin.
Jas. Night, De Bruin.

PUTNAM.

B. H. Bonfoey, Unionville.
Jas. W. Patterson, Xenia.
J. G. Thornburg, Unionville.
Thos. Wood, Terra Haute.
S. Bunker, Central City.
D. W. Pollock, St. John.
David Williamson, Newtown.
Wm. Tinkham, Cleopatra.
Merritt Young, Alberton, Wayne county, Iowa.

RALLS.

J. S. Cleaver, Perry.
A. P. Matson, Saverton.
Geo. W. Waters, Centre.
A. V. Beavers, Madisonville.
J. H. Underwood, Perry.
Chas. E. Johnston, Madisonville.
J. D. Meyers, Perry.
A. S. Smith, Hannibal.
Judge I. T. Dawson, Sidney.

RANDOLPH.

Jno. A. Lowry, M. D., Thomas Hill.
W. H. Broaddus, Darksville.
J. D. Head Huntsville.
Wm. Quagle, Moberly.
Dr. J. H. P. Baker, Clifton Hill.
J. W. Rucker, Higbee.
Chas. H. Dameron, Mt. Airy.
W. L. Landrum, Cairo.
M. H. Morris, Renick.

RAY.

A. Maitland, Richmond.
J. C. Stickle, Orrick.
Henry Cramer Millville.
Dr. Jno. T. Hamilton, Crab Orchard.
F. B. Campbell, Lawson.
M. M. Spurlock, Morton.
W. T. Brown, Richmond.
E. L. Dorsey, Tinney's Grove.
Jerry Adair, Camden.

REYNOLDS.

J. C. O'Dell, Pine Valley.
Jno. S. Luthy, Edge Hill.
Wm. H. Batkin, Centerville.
Jno. P. George, Logan Creek.
B. F. Bucher, Centerville.
T. S. Barnes, Logan Creek.
G. W. Bauley, Lesterville
Jasper Lathim, Edge Hill.
Jasper S. Freeman, Cynthia.

RIPLEY.

Thos. Clarke, Doniphan.
Ira Green, Gamburg.
A. J. Whitwell, Bennett.
B. F. Pulliam, Gatewood.
Wm. R. Dodd, Gatewood.
H. C. Cooper, Varner.
Geo. W. Martin, Doniphan.
W. A. Brooks, Pleasant Grove.
W. A. Murrell, Dry Springs.

ST. CHARLES.

Lee T. Henry, O'Fallon.
L. H. Haigler, Black Walnut.
Jno. Steiner, Portage des Sioux.
H. T. Gerdemann, Cappeln.
G. B. Hitch, Wentzville.
L. W. Hayden, St. Paul.
Wm. Pfarr, Weldon Springs.
Carl Wencker, Augusta.
Henry Gronefeld, St. Charles.

ST. CLAIR.

J. H. Adams, Appleton City.
S. H. Lea, Tiffin.
R. H. Jackson, Ohio.
J. M. Miller, Quincy, Hickory Co.
W. M. Hartzell, Johnson City.
J. H. Vaughn, Lebeck, Cedar Co.
John M. Ragland, Collins.
Thos. P. Moore, Jr., Rookins.

ST. FRANCOIS.

A. A. Rudy, Knob Lick.
P. W. Murphy, Bonne Terre.
Newton Hawkins, Blackwell Station.
H. C. Davis, Iron Mountain.
C. P. Clark, Libertyville.
Samuel C. Gossom, Farmington.
Hezekiah Sleeth, De Lassus.
C. T. Tullock, Bismark.

STE. GENEVIEVE.

Goforth J. Ditch, Bloomsdale.
Alva Culver, Ste. Genevieve.
G. W. Griffith, Coffman.
Jno. Whitt, Farmington.
Charles Burks, Farmington.
N. C. Sebastian, Avon.
Thomas B. Whitelege, St. Mary.
Frank Hoover, Jackson.

ST. LOUIS.

J. W. Hogg, New Alsace.
Fred Schelp, Baldwin.
J. A. Eddy, Affton.
Jacob Gates, Manchester.
T. C. Campbell, Manchester.
Wm. Muir, Fox Creek.
H. Bullard, Des Peres.
C. R. Black, Price.
B. S. Edmonds, Pattonville.

SALINE.

R. A. Tussey, Slater.
T. C. Raney, Marshall.
R. F. Gaines, Marshall.
Samuel Shanks, Brownsville.
R. J. McMahan, Marshall.
R. H. Levy, Malta Bend.
Dr. J. F. Wheeler, Herndon.
C. M. Sutherlin, Arrow Rock.
Abiel Leonard, Mt. Leonard.

SCHUYLER.

W. B. Hays, Lancaster.
Matthew Coffey, Downing.
P. T. McClosky, Energy.
J. J. Daniels, Lancaster.
J. R. Rippey, Glenwood.
J. J. McGraw, Coatsville.
Jno. B. Brenizer, Queen City.
J. F. Dours, Coatsville.
Jacob Whitmer, Green Top.

SCOTLAND.

Ed. Butler, Memphis.
A. J. Woods, Crawford.
R. J. Vaught, Memphis.
John W. Pulliam, Etna.
Henry Hanford, Granger.
P. H. Lancaster, Crawford.
Frank Phillips, Azen.
John Bayne, Unity.
J. T. Spellman, Sand Hill.

SCOTT.

Isaac Hunter, Morley.
Wm. W. Campbell, Commerce.
W. W. Ward, Morley.
George E. Clark, Morley.
E. B. Mills, Sikeston.
J. H. Norrid, Barton.
Jas. P. Ranney, Sikeston.
John B. Moore, Oran.
John Kirkpatrick, Diehlstadt.

SHANNON.

W. J. Randolph, Eminence.
S. D. Biffle, Birch Tree.
O. H. Griswold, Eminence.
Jno. Hearst, Pike.
J. W. Munsell, Eminence.
Alonzo Nettles, River Side.
Isaac Logman, Birch Tree.
Jacob Logman, Birch Tree.
R. M. Bell, Summerville, Texas Co.

SHELBY.

Henry Von Thun, Shelbyville.
James Hanly, Shelbina.
Wm. Croathers, Shelbina.
J. G. Douglass, Oakdale.
Jesse E. Bishop, Maud.
Wm. McCully, Cherry Box.
Z. W. Carothers, Lentner.
Preston Adams, Shelbina.
H. T. Morgan, Oak Dale.

STODDARD.

Chas. E. Stokes, Dexter.
D. S. Crumb, Bloomfield.
W. R. Huggins, Bloomfield.
John Sitton, Dexter City.
Henry W. Hickman, Acorn Ridge.
Judge T. L. Wilson, Bloomfield.
L. H. Hawley, Essex.
John McMillan, Essex.
R. S. McLean, Lenora.

STONE.

J. A. McCullah, Curran.
H. A. Massey, Galena.
W. B. Cox, Oto.
Jas. Owens, Radical.
John B. Pittman, Blue Eye.
John Inman, Sinclair.
P. C. Berry, Galena.
J. S. Crumpley, Robertson's Mills.
Geo. Shepard, Radical.

SULLIVAN.

John C. Schnelle, Pollock.
Summer Boynton, Green Castle.
J. S. Hart, Milan.
Daniel T. Ransom, Cora.
Lewis N. Troyer, Opel.
Dr. A. D. Puterbaugh, Pennville.
Isaac Stanforth, Green City.
Wm. Becker, Wintersville.
J. N. Braden, Pennville.

TANEY.

J. J. Reynolds, Forsyth.
J. C. Johnson, Bradleyville.
S. W. Bunch, Bradleyville.
Creel Hopper, Mincy.
R. S. Branson, Branson.
H. C. Everett, Forsythe.
J. C. Brown, Eglinton.
C. C. Owen, Protem.
J. R. Vanzant, Kirbyville.
C. G. Gossett, Swan.
Jno. Lawrence, Bradleyville.
Jno. Laws, Mincy.

TEXAS.

Wm. A. Freeman, Licking.
Dr. T. Smith, Plato.
Josiah Bradford, Licking.
John R. Farris, Cabool.
J. M. Denny, Mt. Grove.
E. W. Wilson, Oscar.
G. A. Leavitt, Houston.
James Connolly, Raymondville.
H. H. Smallwood, Raymondville.
Jas. Massey, Mt. Grove.
Wm. Cook, Cabool.

VERNON.

J. Q. Thompson, Walker.
Wm. Hall, Walker.
H. L. Williams, Bellamy.
G. M. Wikoff, Sheldon.
R. A. Boughan, Nevada.
Henry Shepley, Nevada.
Dr. I. R. Mills, Nevada.
D. S. Miles, Moundville.
Dr. W. Mellick, Little Osage.

WARREN.

Jas. McIntyre, Pendleton.
John D. Waller, Marthasville.
J. E. Yocum, Warrenton.
Val. Burgess, Marthasville.
R. J. Kennaday, Wright City.
Samuel Price, Loutre Island.
F. H. Drunert, Truxton, Lincoln Co.
James Johnson, Pendleton.
T. B. Bell, Pendleton.

WASHINGTON.

H. C. Thompson, Hopewell Furnace.
Wm. Riehl, Potosi.
Dr. L. T. Hall, Potosi.
John Flynn, Richwood.
W. M. Matlock, Potosi.
H. Hawkins, Summitville.
T. F. Sloan, Irondale.
F. E. McGredie, Blackwell Station.
F. A. Fransworth, Cruise.
Adams & Butler, Belgale.

WAYNE.

R. M. Rubottom, Greenville.
A. M. Costner, Coldwater.
Jas. Carson, Mill Springs.
W. R. Frederick, Greenville.
Thos. F. Estes, Williamsville.
M. S. Warren, Patterson.
C. F. Bruihl, Lowndes.
S. D. Whitener, Gravelton.
Peter Stiltz, Bollinger's Mill, Bollinger Co.
J. T. Lawrence, Williamsville.

WEBSTER.

J. B. Banning, Marshfield.
Thos. Goodwin, Marshfield.
P. L. Dodson, Elkland.
Jeff Watts, Henderson.
H. M. Moreland, Stafford, Greene Co.
B. B. Peck, Rogersville.
J. F. Kindrick, Seymour.
Creed Childress, Seymour.
H. H. Leaf, Conway.
D. N. Mitchell, Marshfield.

WORTH.

Joseph Simpson, Grant City.
A. H. Butler, Allendale.
H. B. Boyd, Irena.
Dr. Willis Marris, Denver.
G. F. Bram, Denver.
Hon. Lawrence Doy, Allendale.
Chas. Hunt, Irena.
Jno. Winemiller, Defiance.
A. L. Corn, Allendale.

WRIGHT.

Geo. R. Crisp, Sunnyside.
W. H. Merchant, Astoria.
S. W. Anderson, Mountain Grove.
B. H. Cantrell, Astoria.
M. Winters, Grove Spring.
John H. Roper, Mountain Grove.
Wm. Hopkins, Marsham.
A. P. Pool, Sr., Mansfield.

REMARKS FROM CORRESPONDENTS.

The following is intended to be a digest of the remarks from our correspondents on questions of practical importance and general interest to the farmers:

ANDREW.

S. K. Faulkner, Whitesville: Our hogs have done very well for a number of years, cattle have been improved, and a great interest has been taken in the improvement of the horse, in size if not in quality. We have a few good sheep, but owing to the lack of protection on wool, the ravages of the wolves and dogs, the number is very small.

Benj. Petree, Fillmore.—While we are not making money now, we are getting in good shape to take advantage of any revival of trade that may occur in the near future. During dull times the progressive farmer accumulates in anticipation of a better day.

BARTON.

J. S. Long, Lamar: Since I have been in this county, I have been trying to study the condition of the farmers and the land, as to its adaptability to agricultural pursuits, and find these facts to exist: at least eighty per cent. of the farmers are trying to cultivate too much land, and about the same number are in debt for their land, and are paying a heavy interest to eastern capitalists. The only men that are making any money or even a good living and keeping even in their finances are the men who turn their grain and grass into beef and pork. This is emphatically a stock or grazing country and not grain, by this I mean small grain.

BOONE.

W. L. Parker, Columbia: The first thing to be considered in farming is the soil. Profitable farming cannot be carried on successfully without good soil, and the best way to build and improve our soil is by grassing. Keep down the weeds and grow all the grass you

can, and should your grass be made into hay, feed it back on the ground if possible. A poor farm can, in a few years, be so improved that it will grow better crops of grain than when first cultivated. Never run your land in grain until it is tired, but get it back in grass, and by that means you may always have a good crop of grass as well as a good crop of any kind of produce which you may wish to cultivate. One acre of good land is worth three of poor tired soil.

CALDWELL.

T. P. Allen, Kidder: The present season has proved that good tillage will make considerable crops with a very small amount of rain. When the drouth began the corn had been cleaned better than I ever saw it before, and that is the reason we have corn.

Jno. McManagle, Kidder: Bogus butter has been used in our towns this summer, but I do not know where it was made. Genuine butter has been very cheap on account of the oleomargarine traffic, which I think is an outrage upon a legitimate business.

CALLAWAY.

J. L. Erwin, Fulton: I must again add my testimony to the value of sorghum as a forage plant, not only for its value, but for its ability to withstand drouth. But for our sorghum patches, I scarcely see how two of my neighbors and myself would have gotten through the drouth this year. Many meadows have been destroyed by insects and drouth, orchard grass alone resisting.

CAMDEN.

Wm. F. Claiborne, Decaturville: I have had some experience in seeding rough land to grass, timothy and clover. I seeded about twenty acres of up land which had been covered with post oak and hickory runners. I had these bushes, which were very thick, cut off close to the ground in August, harrowed the ground well and sowed the timothy seed the first of September. The following February I sowed the clover. Both the clover and timothy took a good hold and made a fair crop the first year, and a very good one the past year. I cut it in the latter part of July. The sprouts came up considerable, but my machine cuts all off, and I raked them up for cattle feed along with my hay.

CARTER.

D. L. Massie, Pike: The building of barns is decidedly on the increase in this county, and those which are being built at present are more substantial and better in every way than those built heretofore. The majority of barns are designed for loose stock with considerable capacity for hay.

CEDAR.

Jno. W. May, Virgil City: I have a little experience with early orange cane which I wish to relate to my brother farmers. I find that it suckers very badly (on account of the drouth I suppose), and there were patches in this county that were almost worthless on that account, while other kinds were all right and made good sorghum.

W. R. Williams, Humansville: Notwithstanding the fact that this has been a very dry fall, and that the corn has fallen very badly, there has been but a small proportion of the present crop gathered. I think the farmers are certainly standing in their own light when they are not harvesting their corn. There would have been a larger crop of corn in this vicinity if the farmers had not planted their crop so thick. If they would select their seed in the fall when it is beginning to get hard, and hang it in some dry place until it has fully matured, there will be no need for planting more than they wish to grow, and in my opinion, corn planted three feet and a half each way, with two stalks in a hill, will make more than when planted thicker.

CHARITON.

Jno. Bayne, Hamden: Considerable interest has been manifested in a large drainage scheme, which had for its object, the reclaiming of many thousand acres of land, which is at present liable to overflow from the Chariton river and its tributaries. But like many other good resolutions it seems to have died in its infancy. Men, especially farmers, are unwilling to assume further obligations requiring money payments for the prosecution of the plans, when under the present circumstances they are unable to pay interest on obligations already incurred, and the immediate future gives no ray of hope.

G. T. Swain, Keytesville: There was a tile factory established in this county some eighteen months ago, and some interest is being manifested in drainage. Some are ditching and filling in with old rails,

straw, etc., and when the good results of this are seen, I think the interest will increase.

P. W. Post, Sumner: There is a disposition (in so for as they are able) to improve and build barns among the farmers of this county, and there has been a decided change within the last few years, caused by the introduction of eastern thrift, and where a few years ago was nothing but the native cattle, can be seen representatives of all the different breeds.

CLARKE.

Jesse N. Moore, Alexandria: I am in favor of deep tillage for most grains. I find that deep tilled soil will hold moisture for a greater time than shallow tilled soil, and what little experience I have had goes to prove to my mind, that corn does better in dry weather on deep tilled soil, as the roots have a chance to take deep root, not being crowded. I have neighbors on three sides of me who cultivate their land shallow, while I cultivate deep, and I find that I have the best corn.

CLINTON.

John Althouse, Turney Station: How intolerable it is to see farmers allow cockle burs and cotton weeds to grow on their farm year after year without trying to put them down. Just think of the land that is being exhausted year after year to grow cockle burs and everlasting cottonweed. Let us fight them.

E. C. Hale, Turney: There has been some draining done in this county with very satisfactory results, and more will be done in the near future. There is a tile factory in Plattsburg, and they find a ready sale for all the tile they can make.

COLE.

H. G. Hamilton, Jefferson City: There is quite an interest manifested in stock raising, with a view of bettering the quality of the stock. The great drawback in sheep husbandry seems to be the dogs, yet if sheep were handled right they would prove to be very profitable.

COOPER.

Thomas A. Bear, Boonville: When I was a boy I learned two things; one was, in buying edged tools, always select those that were

already sharpened. The other was, never hang too much on one nail. Now, my plan is to not build a very large barn, but build two or three; one for my mules and horses; keep nothing else in here, except enough feed to do them a year; the cow barn I have the same, and the two some distance apart. Open sheds are sufficient for loose cattle and sheep. I keep my farming implements under shelter when not in use, but in a building made for that purpose.

W. R. Spencer, Otterville: The barns of this county, as a general thing, are ordinary, yet a few farmers have splendid barns, and our people are growing to belive that barns are indispensible, and several are making preparation to build. A bank-barn is my kind.

DAVIESS.

A. Allen, Jr., Kidder: Does it pay to apply manure to our land, is a question that should be given some thought by a large majority of our farmers. I have found by experience that one good coat of manure, or twenty or thirty loads per acre, will increase the yield about one-fourth for three years. Plant it first in corn, sow it to oats the second year, and wheat the third.

DENT.

B. A. Hedrick, Talladego: The disposition to build barns is increasing very rapidly, and perhaps in a few years every farmer will have a barn, as he should. There is also occasional talk of draining, but no one will make the venture and show the people that it will pay.

DOUGLAS.

W. W. Daily, Beaver: It is the barn that makes the house, and not the house that makes the barn. Our people are all on the barn now, as they are getting their eyes open to the benefits of such improvements. Our people are also taking an interest in raising fine tobacco, and this locality is well adapted to the growth of the weed. We understand more fully the process of curing, and can make a fine wrapper, which always commands a good price. Should any one feel interested in the matter, he may obtain the details by addressing the writer.

DUNKLIN.

E. T. Goldsmith, Malden: I have tilled cotton for the last eighteen years, and find the best methods for its cultivation as follows: First,

put the ground in good condition by plowing and harrowing deep, then bed the land every three feet, and run a light harrow over the beds or ridges before running the planter. As soon as the cotton begins to come up run a light iron-toothed "A harrow" on the top ridges. Shortly afterward, or as soon as the plant will bear, I side harrow with an implement made for this purpose, having four teeth. If necessary, I scrape, but if not, I use a double shovel plow, running deep and close to the plant, and as it gets larger I cultivate shallow, using a double shovel plow or cultivator, with medium sized shovels. I find the taping variety profitable, as it makes larger and better bolls. I think manuring in the hill is more profitable than broadcast, as the crop gets the full benefit of the manure the first year. I advocate deep plowing for any grain, and after wheat or oats, turn your stubble under deep and follow with peas, sowing one bushel per acre, and see what a fine crop of hay it will make. The whipporwill, or gray pea being best for this purpose, and it improves the land.

FRANKLIN.

George H. Ross, Labaddie: There is a growing interest in our county for all kinds of improved stock. They used to think the corn crib was the best pedigree an animal could have, but they have had reasons for changing. We need more blooded stock and more land in grass. I think a law should be passed requiring persons advertising animals for public service, particularly stallions, to record their animal in the county recorder's office, and give, under oath, full information in regard to their breeding, and if such animals have no pedigree, let them be recorded as without pedigree. There is a great imposition practiced by these cross-road stallion parties, and very frequently there is not a line of truth in the pedigrees they give.

J. H. Schweer, Shotwell: Farmers are giving more attention to clover than ever before, and I think they will hereafter sow less wheat and more clover.

GENTRY.

Geo. D. Burton, King City: I think the question of stock-water is the great point of interest now. In this county we have to depend to a great extent, upon ponds, and in a large majority of cases they are so neglected that the stock soon destroy them or keep them in an unhealthy condition, causing more disease among stock than any other one thing.

H. L. Brown, Fayette: The great lesson to farmers for the year

1886 has been the value of grass as a rotating crop. While the extreme heat and drouth of July and August was scorching up the corn crops on all other lands, on clover sod it was green and luxuriant. I have been over much of the county and the unanimous reply to the question, "how much of acorn crop will you raise?" was: on my clover and grass sod I will get 50 to 60 bushels—other ground burnt up—not over 20 or 30 bushels. Fortunately farmers have for several years been giving more attention to grass, and it so happens that this year there was comparatively, a large area of corn after graas. So everywhere farmers are resolving to so arrange their lands that at least a part of their corn shall every year follow clover and grass.

IRON.

Jno. W. Lashley, Belleview: In township 35 north, range 3 east, there is a creek called Saline. Some seeds of Alfala seem to have been thrown into the water, and the plant has been distributed wherever the water reaches. It commends itself for the following qualities:

VITALITY.—It grows on the piles of gravel vigorously where nothing else will grow.

TENACITY.—It has an immense root, and although eaten down to the ground, comes again equal to blue grass.

FERTILIZING POWER.—Introduced on clay soil its great roots aid in drainage, and introduce a large amount of vegetable matter into the soil.

IMMENSE GROWTH.—If protected against stock it will grow ten feet high. It needs support, and so grows best among brush.

TOOTHSOMENESS.—Submitted to a jury of intelligent cows it receives high approval.

PRODUCING HONEY.—The bees work it equal to buckwheat or white clover.

HEALTHFULNESS.—Owing to its strong and rapid growth, it must absorb a great amount of carbonic acid, and yield oxygen largely, and so be valuable in a malarious locality. We would be glad to hear from others in regard to it.

S. D. Russell, Ironton: Most all of our farmers are owners of large barns, in which they keep their hay and stable their cattle. Men who used to stack their hay in the meadow and feed it to their stock on the ground in the mud and slush, have realized that is poor business. Sufficient hay is wasted by being tramped in the mud, to keep the same number of cattle if properly shedded. Some of the cattle of this neighborhood that are fed in the fields during the winter, either come out in the spring dead or so poor that it takes all summer to get

them ready for another winter. While on the other hand cattle that are kept in a barn are always ready for market, and loss by death is a rare occurrence.

KNOX.

Jno. T. Quinn, Richland: Our farmers are devoting their attention to raising cattle and hogs more than any other kind of stock, and the quality of hogs has been improved largely.

LEWIS.

Leonard Ford, Williamstown: Many farms are being drained by the use of ditching machines which work very successfully and give good satisfaction both on farms and public roads. Ditches two feet deep and one mile in length can be made at a cost of eight dollars. Barns are built with a capacity for from two to ten tons of hay, four hundred bushels of grain, and from four to ten head of stock, which are usually tied.

Wm. T. LaRue, Lewiston: About eighty percent of our farmers have horse barns at an average cost of about $400, with a capacity for eight horses when tied. Comparatively few have cattle barns yet. An interest has been awakened in this line, and an improvement is looked for.

MILLER.

N. J. Shepherd, Eldon: In raising roughness to be used in feeding stock it is always an item to secure as large a crop as possible from a small acreage. In order to winter stock economically cheap feed must be secured. It does not pay to winter stock with simply feed enough to keep them alive, they must be kept in a good thriving condition in order to secure the best results.

We have the millets and clover, orchard grass, red top and timothy, and fodder corn as the principle alliance for rough feed during the winter. Johnson grass and oat grass with milo maize, Egyptian rice-corn and sorghum have not as yet been fully tested in this State, at least sufficiently to fully illustrate their value.

If we could induce farmers in different sections of the State to give each of them a fair trial and report, in this way to a considerable extent, we can ascertain how each would yield in different sections and be better able to judge of their value.

I have tried milo maize and Egyptian rice-corn, preparing good prairie soil by plowing and harrowing until in a good fine tilth and then sowing the seed carefully in the spring. The milo maize failed to ripen only a portion of its seed, the rest was badly injured by frost. The rice corn did very well but I can see no especial advantage it possesses over our common cane. Early Orange cane planted along side of

it will give fully as good a crop of forage and seed as the rice corn and will make as good a feed. Of course I am aware that one year's test is hardly sufficient to test it fully, but this is the result of one year's test. I have a small patch of Johnson grass and also tall oat grass sent out last year. Both made a fair growth but hardly sufficient to compare with others that we already have.

While we ought as farmers to give all the aid possible to our State College in securing proper measures to make experiments, yet many farmers can aid in these tests by securing a few seed and testing themselves, taking pains of course to secure as fine a result as possible and then reporting.

Potatoes.—For several years I have been making as careful experiments as possible with a view of, as far as possible, determining at least to my own mind, settling or deciding certain questions as to the best methods of cutting, preparing the soil, planting and cultivating.

Believing that in very few cases one experiment tried, one season would be by any means conclusive. I have, unless the results were so self-evident as to need no repitition, tried each experiment at least three seasons, and by keeping a record each year of the time and manner of cutting, planting and cultivating, as well as the results secured by using different fertilizers and cultivating in a different manner, the summing up of these should give reasonably correct results.

I have used all reasonable caution to use each year with each series of experiments, soil as nearly of the same quality as possible to give the same cultivation, and I may add that I had no pet theories to prove or desire to show any one plan to be the best, but simply to learn what I could from actual experiments. As to fertilizers on a fine prairie loam soil I have tried unleached wood ashes, stable manure well rotted, poultry manure well rotted, night soil, liquid manure, lime and saw-dust, and complete fertilizer. Each was applied in the hill and thoroughly worked into the soil. All were planted the same day, from seed cut at the same time, and from the same lot a pound of each weighed accurately and planted and cultivated in the same manner. Ashes gave the best results, complete fertilizer next, poultry manure next, while one experiment with saw-dust entirely satisfied me that an application would do more harm than good.

I consider it necessary to take pains to work whatever fertilizers are applied thoroughly into the soil. I have tried using small potatoes for seed, whole and cut, and also good medium sized potatoes cut and whole, cutting to single eyes, and planting a single eye in each hill, and planting two eyes in each hill, and the conclusion I have arrived at is that while a good crop may be sometimes secured in a favorable season yet better results can be secured by using good medium seized potatoes,

cutting, as nearly as possible, so that a portion of the heart of each potato would be with each piece, dropping two cuts in each place and having the hills eighteen inches apart in the rows and the rows about three feet apart. Have the soil mellow and after dropping the potatoes step upon them so as to press firmly into the soil, and after covering well, step upon the hill to firm the soil well down upon the seed.

I have also tried planting in hills three feet apart each way, of drilling, that is planting the hills one foot apart in the rows; while the work of cultivating is much easier when planted so that the work of cultivation can all be done with the cultivator, yet the decreased number of hills made the crop fail to be as profitable as I considered necessary. And planting so close did not give the plants sufficient room and at the same time increased the labor of cultivation without a sufficient increase in the yield to make the extra work profitable. In regard to cultivating, I prefer to keep the surface as nearly level as possible, when the potatoes first come up a good harrowing can be given profitably, this destroys the weeds and fines the surface. The first cultivation given with the cultivator, I try to made as deep and thorough as possible, and then stir only the surface, keep the surface mellow and fine and do not allow the weeds to grow.

While in a wet season, hilling up may give fully as good results as level, in a dry season, level cultivation will give decidedly the best crop, and as the soil is left in a better condition when kept level, I prefer this method.

MORGAN.

Jno. H. Alfter, River View: The last two severe winters have taught the farmers that barns are better shelter than brushy hillsides, and they are beginning to build good and substantial barns for their stock, which I believe will pay one hundred per cent. on the investment.

OSAGE.

Henry Gidinghagen, Linnwood: We see the great mistake in not having shelter or our stock. At least forty per cent. of our lambs are lost on account of exposure, and many calves die for want of protection.

RALLS.

A. V. Beavers, Madisonville: After twenty-nine years' of experience in wheat raising in this country, I find that early plowing and

early sowing is the best. My best yields are from land that was broken in July. Hence, I claim that all the plowing should be done in July and the first of August. The sowing between the 10th and 20th of September, I find not only an increase in yield, but also in quality, by observing these rules.

Judge I. T. Dawson, Hassard: We have quite an interest in the improvement of stock of all kinds, and scrub stock in our county is a thing of the past, as we have long since passed them by. The old fogies had to either fall into line or get left.

RANDOLPH.

Jas. W. Rucker, Higbee: I notice that farmers are reading and studying more than ever before, and the result is an abundance of everything, more profits and more improvements.

ST. CLAIR.

J. H. Adams, Appleton City: My experience is that shallow plowing for spring crops and deep plowing for winter crops is the best. Better corn is raised on fall plowing than ground that is plowed at any other time.

J. M. Ragland, Collins: Those who thinned their corn to two stalks in a hill and plowed shallow made much better crops of corn this season than those who left their corn thicker and plowed deep enough to destroy the roots during the hot, dry weather.

DRAINAGE.

I have before alluded to the importance of drainage and the purpose that the notes of correspondents and others upon this subject were intended to fill. They clearly serve to show that there exists a far more pronounced belief in and use of drainage in this State than has been dreamed to exist. We are evidently on the eve of a rapid extension of drainage in Missouri. The meetings of this winter have revealed a general interest in the subject. This interest has always been coupled with a general belief that drainage will not succeed over the compact subsoils of Missouri. Both practice and science disprove this view. The notes will show that drainage is working admirably in this State on our worst soils. Success is the final answer. Yet the reasons for this success are not valueless. It seems that the removal of the surface water to a partial degree admits air more freely, and though at first for a limited area, yet this limited area is ever increasing, the air acting on new areas to open the soil a little by chemical changes. This influence gradually widens, until the physical condition of the soil to the depth of the tile is changed. By this means the wet area is increased and the water-holding capacity of the soil is increased.

This latter influence is a very important one. So long as our compact subsoils resist the free entrance of water into them, sharp rains are bound to overflow the open surface soil and run off into the creeks. The moment the subsoil becomes open freely to water, then they absorb the rains and store them to the extent of the capillary power of the soil. The water-holding capacity of the soil is thereby increased and moisture is stored for drouths. Thus drainage makes such soils actually less subject to the evil influence of drouths.

But so long as water is retained upon the surface, so long air is mainly excluded from the soil and soil decay at a standstill. This is seen in trees, limbs and leaves in peat bogs thousands and millions of years old, yet undecayed because air has been excluded in these water-saturated bogs. I do not propose at present to set forth the philosophy of drainage, but rather to draw attention to its acceptance and

successful use preliminary to a future and more thorough consideration of the science and art of drainage.

The following suggestions and cuts I take from an experienced and competent authority, Prof. Carpenter, of the Michigan Agricultural College. It expresses the usual views on the points covered.

KIND OF UNDER-DRAIN.

"Under-drains are best constructed of tile, and the shape best suited for every place is the plain cylindrical form. The tile are now usually laid with the end abutting against each other, leaving as smooth a channel as possible for the water. In soil that is not easily washed, no protection at the joints is needed; in sandy or peaty soils the top should be covered, so that the water will be forced to enter at the bottom of the joint; it will then be likely to be free from sediment. The best covering for joints of tile is, in my opinion, a piece of closely mown turf, laid grass down. This is especially good, as it seems also to prevent lateral displacement of the tile. Small pieces of tarred paper, of old tile, tin, etc., answer a good purpose. Tarred paper is always cheap and convenient to use. Turf is sometimes objected to because of the silt that may be worked into the tile. The water gets into the tile principally at the joints, though tile is in itself porous. This was strongly illustrated by a construction that was carried out by the Lansing Wheelbarrow Works, owing to a misunderstanding of some of my directions. In laying the tile the joints were completely enveloped with tarred paper. The result was that no water entered the tube tile, and the paper had to be removed before the tile would work.

TILE LAYING TO GRADE.

"As already noticed in a previous place, this requires much care. It is usually necessary to test the bottom of the ditch in advance of laying the tile, and also every tile after it is laid. As this work will be a permanent job, if done well, no pains should be spared in laying the tile, which is the least laborious part of the work.

"My method is—and this method has only to be tried to be adopted by all—to stretch a strong cord about three feet above the ground and get this parallel to the grade required as shown in figure one.

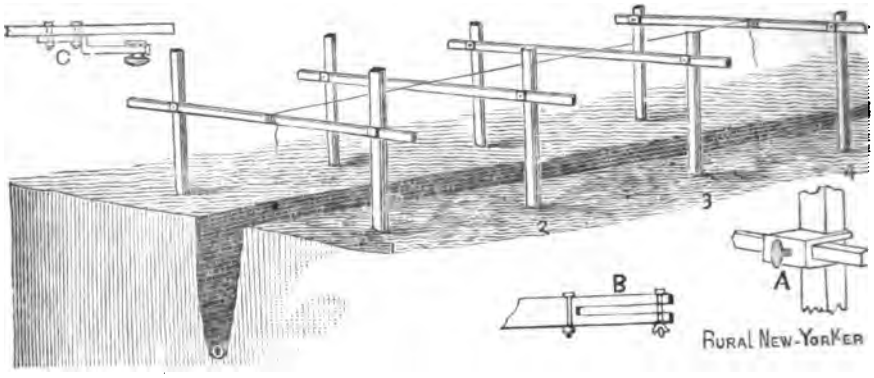


Fig. 1.

"Now by supporting this string at intervals of thirty feet the variation from a straight line will be insignificant, and by measuring down the required distance one can determine the correct bottom of the ditch with exceeding accuracy and with great celerity. This method of preserving a true line for the tile I wish to call particular attention to; for it may be used not only to preserve the grade line, but to secure it it, and hence be a substitute for a line of levels. Figure one shows, I think, quite clearly how the string is carried, the stakes or posts are driven on opposite sides of the ditch, and then connected with a cross-bar. This cross-bar should be arranged so that either end can be raised so as to be made truly level. For this purpose three forms of clamps are shown in detail at A. The common quilting-frame clamps would answer very nicely. If a survey has been previously made and the depth at each point is given, the cross-bars are set by measuring up from the surface so as to be a uniform distance from the bottom. They should be seven or eight feet above bottom of the ditch, where they will not interfere with tile laying. Over the center of the ditch on the cross-bars pull the line with a stick whose length is equal to the height of the line above the bottom, say seven or eight feet, as the case may be, the bottom can be readily tested.

"If no survey has been previously made we can use these to determine the fall and the grade line. For instance, at one inch (Fig. 1) we set our first cross-bars and stakes, say so as to give a depth of four feet. At the fartherest distance that can be seen we set another cross-bar and stakes so as to give us the required depth at that point, say three feet. To find the fall between these two we have only to sight over a level of any construction from over first cross-bars. This last method is a rough one and will serve only to show whether we have

any fall or not. After we find there is sufficient fall between the two cross-bars any number of intermediate ones can be set by sighting, and very accurately too. Leave these in until the tiles are laid under any given one and you will find your work done with all the accuracy needed, and in very much less time than if you had attempted any method which depended on leveling the bottom itself. This method will substitute certainty for uncertainty and give you success, where by laying tile by the eye or running water you would be likely to fail.

LAYING THE TILE.

"It is not a good plan, unless the bottom is unusually hard, to walk in the ditch after it has been prepared for the tile. If tiles are laid by hand, the better way is to keep about one foot of earth filled over the tiles, and standing on that, reach over and lay the tiles. This gives an excellent position for using the push-and-pull tile scoop, and in sandy or mucky soils where the tiles laid need frequent cleaning by hand, it is certainly the best method. The bottom is tested in advance by measuring from the over head string, and each tile is tested after being laid. In peaty or mucky soils great care is necessary that the ditch be not excavated too deep. No random filling will give as uniform a bottom as the original undisturbed muck. It might be a good plan to excavate several inches below the grade line and fill to the grade with gravel; but this is hardly necessary. In quicksand the side pressure is more likely to cause the tiles to rise, and the ditch should be filled at once to hold the tile down. No board should be used for bottom in either case. Tile will settle uniformly if the soil is of the same character throughout. In quicksand no alarm need be felt if the tile fills one-half or three-fourth full of sand when the work is progressing. If there is any current whatever, sand will wash out clean by a flush of water. It is a good thing in such soils to keep a long iron rod in the tile, to be worked ahead occasionally to prevent the sand from settling in the tile. The joints of tile in quicksand and muck should be made as close as possible, for which a wrapping of tarred paper is excellent. Collars might in such soils serve a good purpose. Where the soil will stand well the tiles can be laid from the surface with good results. A pole with an iron pin long enough to hold one tile, is commonly used.

"Fig 2 is a view of the instrument usually used for this purpose. A much better arrangement for small tile is shown in use in Fig. 3.

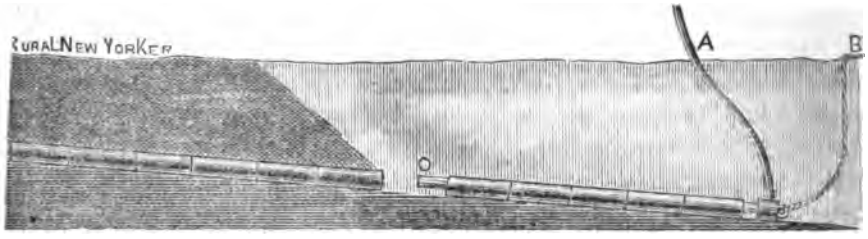


Fig. 2.

"The rod on which the pipes are strung is sufficietly long to hold six tiles, and be inserted six or eight inches in those previously laid. They can be laid and the joints wrapped, if necessary, while on the pin. After the tiles are laid they are at once covered sufficiently to hold them firmly in place, and the pin is pulled out with the rope attached to it. An old scythe handle is the best form for the handle to the long pin. The diameter of the pin should be such as to slip into

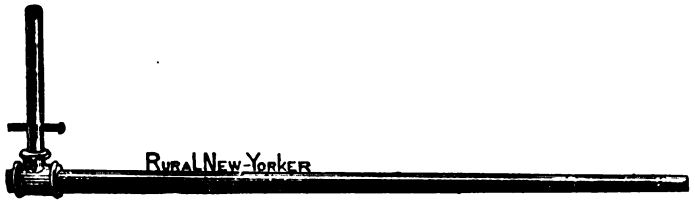


Fig. 3.

the tile easily, but not much smaller. In filling, care must be taken when the dirt is first thrown in, not to move the tiles latterly. After they are covered to a depth of about a foot, if the ground is sufficiently solid the filling can be done with a team and scraper very cheaply. Use a long chain and keep the scraper on one side and the team on the other.

WILL IT PAY TO DRAIN?

"This is a question put very frequently, but yet one that is difficult to answer in a general way. There are circumstances to be taken into account that may make special cases very different from ordinary ones. I could fill the whole time with examples showing that worthless land of little or no value had been converted by drainage into land whose selling value was $50 or more per acre. I could give repeated examples showing that the productiveness of land had been increased 100 or 200 per cent.—by such a comparatively trifling ex-

penditure—but I will trouble you with only one of two cases. You need only look around you to see them.

"It will never pay to under-drain, unless you are prepared to do it properly. Every case of failure to reap benefit by drainage can be traced to some fatal error in the plan or construction of the drain. The proper construction of a line of tile drain in order to obtain its maximum efficiency, requires as much or more accuracy than the finest cabinet work. Every deviation sidewise from a straight line detracts from its carrying capacity; every deviation up or down from its grade line is more or less fatal to its efficiency. The country is full of ditchers who, according to their own story, have laid miles of tile in England or Ireland, who pretend to have the skill to determine the proper inclination of the grade line entirely by the eye. I have tested the work of some of the best men of this class (one, especially, Mr. Wheeler, who was the best ditcher I ever saw) by running a level over the bottom of the ditch after they supposed it was fitted to receive the tile, and I have found variations from the grade line within forty rods equal to one foot in depth and sufficient to nearly destroy the value of the drain.

"My own opinion is that ninety per cent. of the class of work done by these men is more or less a failure, and that there are miles of drains in operation not running to one-half or to one quarter their full capacity. This, of course, means that for the benefits received, too great an expenditure has been made for tile. Now it will never pay to lay tile unless they are laid in such a way that their full capacity is utilized. It does not pay to give twenty-six dollars per thousand, forty four cents per rod, for four inch tile and have them laid so that they will only do the work of two-inch tile, worth ten dollars per thousand, sixteen and a half cents per rod; yet this is done more frequently than many would suppose. It is often done for men who feel fully satisfied that they have had a good job done, simply because they do not know what a good job is.

"In all ordinary cases it will pay to drain, and in any case it will pay to take such precautions as will insure you that your tile will work to full capacity."

DRAINAGE IN MISSOURI.

The circular asking for facts concerning barns also contained the following questions relating to drainage:

1. What proportion of your county needs drainage?
2. What proportion of your land needing drainage is drained?
2. Is there any interest being manifested in drainage in your county?
4. Give any positive evidence you have of the profits of drainage.

The proportion of our land needing drainage is 19.3 per cent. as returned by the correspondents. Only seven per cent. of this is drained if the correspondents have not erred in the estimate in answer to the second question. In answer to the third question a majority report little or no interest in drainage. For answers to fourth question see the following notes:

ANDREW.

Newton Bird, Avenue City; The drained land of our county yield better crops and is considered our best land.

S. K. Faulkner, Whiteville: The land near our rivers being higher than the bottom land adjoining makes some system of drainage a necessity, and I am of the opinion that tile draining will work well in our alluvial soils.

————————, ————: I have had some experience with tile; put in a number of brush drains and used a "Mapes' sub-soil plow" on several acres, but failed to see the benefits, hence I have but little faith in tile draining on our clay sub-soil. Have a 100 foot drain from my cellar which does not take the water away and know of several drains to wells which do not drain ten feet from them.

ATCHISON.

R. Buckham, Langdon: Where drainage has been tried in this county I think it has proven very advantageous. There has been but little tile draining done in this county, but in the eastern portion the mole plow has been used in the swags and seems to do quite well, but will not probably last long, as it is likely to cave in. In the river bottom where I live we dig ditches through the lowest land to run the water into the creeks. This answers the purpose very well in cases of heavy rains, but will only carry the surface water; does not dry the

land as it should be, and as tiling would do. I have tried to get some one to start a tile factory in this county, but have not as yet succeeded. The farmers would drain if they could get the tile without paying the freight.

AUDRAIN.

R. N. West, Mexico: Wm. Reed has put in considerable tile this summer. He put in one drain last spring which prompted him to put in more. He is confident that tile will work here.

BARRY.

H. S. Montgomery, Washburne: There has as yet been but little tile used in this county, but bedding has been practiced to some extent and seems to give good satisfaction. Damp lands in grass pay better than tiling.

BARTON.

J. S. Long, Lamar: I have seen no tile or other draining since I have been in the county, but think the time is coming in the near future, however, when much of the land in this county will be underlaid with tiling.

Chas. Price, Irwin: There is but little bottom land in this county, but there is a great deal of high, level flat land which would be greatly benefited by drainage.

BATES.

H. Miller, Foster: I have had but little experience in drainage, but from observation I know that flat lands have little advantage over rolling lands in dry weather, and in wet weather the rolling lands have decidedly the advantage; hence, there must be large profits in drainage.

BOLLINGER.

Henry J. Murray, Sedgewickville: I am satisfied there is land in this county which would be benefited by drainage, but can make no estimate.

Jas. G. Woodfin, Shopperville: The subject of drainage opens up a broad field for discussion. Suffice it to say, however, that there is little draining done in this vicinity, and that which is done is not of a

permanent character. There is no doubt in the minds of any intelligent farmer that no better investment can be made. But the lack of sufficient surplus capital with the farmers and the high price of tiling will materially retard drainage until these causes have been removed.

BOONE.

W. L. Parker, Columbia: In surface draining I find the surface soil changes its color from a whitish ashy to a dark gray and becomes much more productive. Where a soil is covered with water during a large portion of the year it becomes lifeless and takes on a whitish color. I do not know how underground draining would work here in our soil which is so close and compact, especially when tramped, but I fear the water would not reach the tile.

BUCHANAN.

Wm. M. Matney, Platte River: I am cultivating land in Platte river bottom which was under water two thirds of the year about thirty-five years ago, and was then thought to be worthless for farming, yet I have used only the surface or open drain. There has been but two persons in my neighborhood who have made covered drains, and these were only on a small scale. The most of our land is easily drained, as there is sufficient fall to carry the water into the river or streams tributary to it, and my experience, extending through a period of about forty years, has taught me that bottom land is the best for either cultivation or meadow.

BUTLER.

James F. Tubb, Poplar Bluff: I am acquainted with several tracts of land that have been drained and their value has been increased at least fifty per cent.

CALLAWAY.

P. B. Gingrich, Fulton: My experience with drains is somewhat limited, but I am well aware of the benefits they produce. I have underdrained land in Pennsylvania, using stones instead of drain tiles, and the result was that land which before was unproductive became productive, the drain carrying off the surplus water and admitting air and light into the soil produced the desired result. Land that is flat and wet will hold clover only about one year, but underdrained it will hold it much longer.

R. O. Humphreys, Guthrie: I had a flat field which received all

the water from a long slope or hill, and was being washed out in little gutters or gullies by the overcharge of water. I drained it in a bungling sort of way and effectually stopped the wash.

G. C. Thornton, Cape Galena: I think drainage would increase the value of our land at least fifty per cent. There is a great deal of land in Osage Valley that is unfit for cultivation for want of drainage, and the amount of farming land would be increased twenty-five per cent. by such treatment.

CAPE GIRARDEAU.

W. E. Lang, Appleton: The southern part of this county is sadly in need of drainage. The soil is very fertile, but the surface is flat and no natural drainage is afforded. It cannot be drained without a considerable outlay of money, but I think there has been a "drainage company" organized.

W. A. Ranney, Cape Girardeau: In this vicinity most of the drainage is done by open ditches, which are generally not sufficient for the best results. On a piece of land which was unproductive, yielding from five to fifteen bushels, I opened a ditch two feet deep and put in three plank, two edgewise and one top, and covered it with dirt. The increase was at least fourfold. Samuel Hitt, Sr., put in some tile on a wet piece of land, and I believe he is highly pleased with the result.

CARROLL.

W. T. Mayfield, Roads: To my knowledge there has been one farm drained in the southern part of the county which is in a low, swampy locality and considered to be almost worthless, but since being drained it is one of the best farms in that portion of the county.

F. M. Marshall, Norborne: The advantages of draining may be summed up in the following: First, it improves the healthfulness of the locality; second, it makes the land more pliable to culture and of easier cultivation; third, by drainage you can cultivate land that would not otherwise be fit; fourth, it increases the production of the land, both in quality and quantity.

Marion Shirley, Bogard: Drainage improves the healthfulness of the locality; hence it is beneficial to both man and beast.

CHARITON.

James Sanderson, Malcolm: Twenty years ago I assisted in draining about fifteen acres of land which was then too wet to produce corn or potatoes, as it was too wet to be plowed before June, and when the

season was wet the crop was a failure. The soil was from one to two feet deep, black and rich, with a stiff clay subsoil. The ditches were dug forty feet apart and four feet deep, and two inch tile was used. This land was then fitted up for a fruit and vegetable garden, and to my certain knowledge it has produced the very finest fruits and vegetables, including grapes, strawberries, cucumbers, melons, etc. It was valued at $40 per acre before being drained, but it will now pay interest on $500 per acre. It is located in Cook county, Illinois.

CLARK.

H. Stout, Winchester: Experience has demonstrated to me that flat lands are improved at least forty per cent. by drainage. We use the flat drain instead of the tile.

CLINTON.

Jas. Williams, Cameron: The best corn I raised this season was on what was once a lake, but had been tile drained. I think it would have yielded seventy bushels per acre, while my general yield would have been about forty bushels, had the season been favorable. There is no doubt in my mind about drainage paying when tile can be had in the vicinity, avoiding the cost of freight and breakage. I have had some experience with drains for the last five years and have come to the conclusion that there is not forty acres of land in this county that would not be benefited by putting in a drain on some part of it.

COLE.

Elias Elston, Elston: I apprehend that the profits of under-draining consists more in theory than in practice in regard to a great portion of the cultivated lands of Cole county. Some good results have been obtained, however, by cutting open ditches. Some of our farmers who are from the State of Indiana, where draining is the rule rather than the exception, seem to think that only about twenty-five per cent. of the lands in this county would be benefited by drainage. Is not the theory wrong altogether?

COOPER.

Thos. B. Bear, Boonville: I have cultivated a farm for the last fifteen years which is about one-half bottom, and I consider that proper drainage increased the crop one-half. A very good way to drain

is to make the ditch, place two cordwood sticks side by side and four inches apart, lay a third piece on top and cover with dirt. This is a good way for a poor man who cannot afford tiling.

D. F. Nixon, Harriston: I have seen lands entirely worthless, in Ohio, made worth $100 per acre by drainage. In some instances drainage would be profitable in this State, but land is too cheap to make it very profitable.

W. R. Spencer, Otterville: Hundreds of acres of land near here would be worth from fifty to seventy-five per cent. more if drained and many acres entirely reclaimed.

DENT.

B. A. Hedrick, Talladego: There are several drains through our farm, and I have noticed that wheat does not freeze out as badly along the ditches as elsewhere, the soil does not get as hard and can be worked from one to three days earlier after a rain.

DUNKLIN.

E. J. Langdon, Cotton Plant: There are many places in this county where the surface is dish-shaped; consequently drainage is necessary for successful cultivation. I have had some experience in drainage, and to locate my drains I watch the course of the water as it descends from the uplands in times of heavy rainfall and put them where the discharge is made into the sloughs below.

GREENE.

J. F. Brooks, Republic: I have had considerable experience in drainage in Livingston county, New York, and in many cases the first crop of wheat or clover would pay for the cost of tiling. We used one-inch tile for side or branches, with from three to four-inch pipes for main drain. The side drains were from two to five rods apart, the formation of the surface determining the frequency. The soil varied from sandy ridges, with clay subsoil, to a tough clay, and in some, the low places, there were alluvial deposits underlaid with quicksand.

GRUNDY.

J. Barnes, Edinburgh: The evidence of the profits of drainage is that where land has been well drained; it produces thirty per cent. more than undrained land.

HARRISON.

J. M. Bryant, Bethany: I knew a man who, by digging a ditch three hundred yards long, succeeded in raising a good garden on land that was before almost worthless, and also furnished plenty of running water for his stock during the severe drouth of last summer.

HOWARD.

H. L. Brown, Fayette: During the severe winter of 1885–6 while the ground was frozen solid the drains were discharging water freely, and in the spring when the land thawed out instead of being miry and wet was the first land fit for the plow.

IRON.

J. R. Adams, Goodland: To drain in a small way, dig a ditch two feet wide and four feet deep and fill with the loose rock that are in the way of the plow to within a foot of the top, leaving an outlet at the end and throwing the dirt back. The loose stones on the bottom will act as a drain and are as good as any pipe.

W. W. Heywood, Ironton: I have on my farm of about seventy acres near 1,000 feet of drain. I first opened the main drain across my farm from north to south, making it from two to four feet wide, and from one two feet deep. Into this are run six covered drains from one to three feet deep and wide, enough to work in. I had no tile, hence I used rock, placing a large flat stone on each side and covering this with a smaller stone, then fill the ditch with dirt. The land is now dry and easy to work, while before being drained it was cold, wet and unproductive. My wheat yielded fourteen and three-fourths bushels on the part drained. There is no end to the advantages of draining, and I expect to derive benefits from my drains so long as I live. It will pay on every farm in Iron county, but as yet no pride is taken in such improvements.

Jno. S. Luthey, Edge Hill: Underdrained land will yield fully double the crops obtained from the same land without drains.

JEFFERSON.

V. Price, House's Springs: My experience with draining in this county is limited, yet from what I have seen in Indiana am satisfied that the wet slough land of this vicinity could be greatly benefited by

underdraining, as it not only dries the ground but causes it to retain its moisture better in times of drouth.

JOHNSON.

Wm. Mohler, Warrensburg: My experience with tile draining is that it is of great value, because land when drained can be worked earlier in the spring, becomes of a warmer nature and resists drouths better. As a result we get our crops out earlier, get a better stand, the ground is in better condition to work and the crop does not drown or burn up. But best of all, at harvest time we have in many seasons double the yield we otherwise would produce.

J. P. Ozias, Centre View: I have about 2,500 feet of drain tile laid, but most of it is used in draining side-hill springs. Before being drained the water would seep out and submerge an acre or more of ground, rendering it worthless for cultivation. But since being drained it is the best land I have, and besides it concentrates the water supply so that I now have a good spring where the pipes empty into the main drain. Tile should be put from two to three feet deep, using not less than three inch pipes. The larger the tile the better the result obtained, and I think four or five inch tile is the best size. As to cost, that will depend largely upon the distance the tile is to be shipped, as the freight is usually more than the original cost. We have two tile factories in this county and it will be much cheaper than heretofore, hence there will be more draining done.

KNOX.

Wm. Anderson, Plevna: I have some land that before being drained was of very little value, but which now produces very fine crops.

LACLEDE.

Jno. W. Smith, Conway: I notice that comparatively worthless land is made very productive by drainage.

LAFAYETTE.

J. Garland Webb, Corder: I have used no tiling for draining, but my neighbors have, and land that before being drained was not susceptible of cultivation now yields as good if not better crops than the other land.

LAWRENCE.

E. S. Allen, Mt. Vernon: I have not had enough experience in drainage to say how much the profits are, but we are satisfied that it will pay.

J. W. Downing, Hall Town: Have tried drainage but little, but know that it will pay well.

J. R. White, Verona: But little of our land needs drainage, yet that which has been drained pays well.

LEWIS.

Leonard Ford, Williamstown: Drainage is the only way by which flat lands can be made productive in wet seasons.

W. H. Wallace, Lewiston: A flat piece of bottom land was reclaimed by drainage and I am informed that it works nicely.

LINCOLN.

Finley Wallace, Brussels: Drainage pays well. I was familiar with drainage in some parts of Illinois, and have known flat swampy land to be reclaimed by this method and made the most productive farming land that could be found.

LIVINGSTON.

J. E. Jackson, Chillicothe: I have had no experience in drainage in Missouri, but in Ohio it payed from one to two hundred per cent. on the investment.

MADISON.

Jos. Deguire, Fredricktown: A portion of my land is inclined to be wet, and for three years after clearing it up I made very light crops. I have since drained a portion of it, however, by cutting open ditches, and it now produces well and is of easy cultivation.

MARIES.

Dean W. Tainter, Vienna: At Richfountain, Osage county, there is a level between two ridges which was worthless on account of not draining, but it was finally drained, requiring three or four miles of ditches, and it now produces well.

*HARRISON.

I. M. Neff, Bolton: Almost one-fourth the land in Harrison county would be greatly improved by draining, but less than one per cent. of that needing drainage is drained, except that the water is allowed to wash ditches from one to twenty feet in depth. There are such ditches in this county that have been washed within the last few years, and it now costs the county more than one hundred dollars for each time they are bridged. In some instances they have been started by attempts to drain the road, but I am glad to say that some men are working nobly to put an end to this ruinous work. The public have not been properly aroused to their own interests in drainage which will prevent the land from washing in ditches; their soil from washing off, etc.

The sloughs and valleys of our hill land will pay a larger per cent. on money invested in drainage than our flat prairies or bottom lands, as the latter are underlaid with "hard pan" or gumbo, which hinders drainage in a measure.

Having observed closely the influence of drainage on the soil for the last twenty years, I arrive at the following conclusions:

The locusts, earthworms, etc., etc., will mellow the soil in rich ground about as deep as it is drained; more water is absorbed from rains, which naturally requires a greater time for evaporation in times of drouth. It will bear planting and cultivation much earlier than undrained land, as the soil is of a more lively nature, and the older the drains the better the land is drained; it gives a more rapid growth, and not only insures a good crop, but is convenient for growing a second crop on the same land; and last, but not least, if properly arranged, the drains will furnish a constant supply of running water which will not freeze in winter, and is always pure, fresh and cool in summer.

These facts have been realized by the writer many times, and especially has our well drained garden been a luxury this past dry season. While the rainfall for the period extending from May 14 to August 14 was but one and one-fourth inches, our garden was luxuriant, and from a row of tomatoes one hundred and eighty feet long we gathered twenty bushels; from three hundred sweet potato plants we secured forty-three bushels; one-fifth of an acre of Monarch strawberries yielded eight hundred quarts; also, a turnip in the same garden

*By an oversight of the printer, the remarks of Mr. Neff, of Harrison county, and Mr. McBride, of Henry, were overlooked at their proper place; hence their introduction here.

measuring thirty inches in circumference, weighing ten and a half pounds; a radish thirty inches long and twenty inches in circumference, and other things in proportion. Yet this has been the poorest season since 1860.

Our first object in draining this garden was to secure running water for the barn yard. The bottom of the drain was nearly level for fifteen rods, wherein we made a mistake, as it should have been perfectly level in order to fill the entire space of the ditch when the water was one foot deep in the tank. It now furnishes our basin with a supply of pure water, leaving an acre of deep, sandy soil for a garden. From this main drain we have eight side ditches extending some distance up the hill and about forty feet apart, which completes the system. These side ditches are from two to three feet deep, varying according to slope. Think of and care for your land as you do your fine horses and it will always yield you good returns.

HENRY.

D. E. McBride, Garland: I saw some marshes drained which, before being treated in this manner, were worthless, but now produce fine crops of anything planted there and stand the drouth best.

MILLER.

Wm. Hauenstein, Tuscumbia: My father drained a piece of boggy land in one of his fields by cutting a trench and filling with some loose stones to within ten or twelve inches of the top, then leveled with soil in order to plow over it. From that time on the boggy land was tillable and productive, but before no team could cross it.

MORGAN.

Jno. H. Alfter, River View: Some few of the stagnant ponds and swampy bottoms in the southern portion of this county have been drained greatly to the advantage of the land as well as the healthfulness of the community. Lands that before being drained were good for nothing except frog ponds, have this season yielded seventy-five bushels of corn per acre.

L. J. Baughman, Florence: I know of one case in this vicinity where a large farm was made very productive by the use of tile draining. Before being drained it was worthless in wet seasons, but now drains well. We have a tile factory in this county and large quantities are being used.

B. R. Sanburn, Search: Much of the land on the Osage bottom has been drained in a rude way. Some by open ditches, some by closed drains, timber being used instead of tiles, and the results have been highly satisfactory, more than doubling the production of the land so drained.

NEW MADRID.

C. C. Thomas, Point Pleasant: What little land is drained here is done by means of open ditches, and it increases the yield at least twenty per cent.

NODAWAY.

M. B. W. Harman, Pickering: I laid 4,000 feet of tile in the fall of 1882 to test the profit. They were laid four feet deep and I used from four to five inch pipes. My drains are all running well and I estimate my profits on the investment at fully thirty per cent. per annum. I intend to tile my entire farm. We have two factories in this county and they are kept busy.

OREGON.

Benj. Gum, Alton: There has been some land drained in this locality which now produces well, but before being drained produced only frogs and malaria.

PERRY.

Jas. Rice, Bois Brule: I drained a lake some time since that before being treated in this way was worthless during wet seasons, but is now dry and produced last year fifty bushels of corn per acre.

PHELPS.

O. P. Paulsell, Rolla: Several years ago I drained a small piece of land that was too wet to produce anything but red top, and it has been very successful as I now grow good crops of any kind of grain on it. I filled my ditch with loose rock to within eight inches of the surface.

PIKE.

W. F. Oglesby, Clarksville: Two of my neighbors have drained quite extensively and the results have been very satisfactory. In one case the land before being drained was almost worthless, but now it is

his best and driest land. Of 400 acres about fifty have been drained and where water formerly stood for weeks at a time seventy-five bushels of corn or thirty bushels of wheat per acre can be grown. Mr. Gillum, the owner, thinks the drains have increased the value of his entire farm at least ten dollars per acre. Another case where my neighbor, Mr. James, drained twenty acres, using about 400 yards of extra tiling to carry the water from the drains in his field to a lower level and he claims that it has paid better than any expenditure for improvements he ever made.

PULASKI.

O. B. Vaughan, Tribune: There have been a few good fields made by drainage in this locality and where water formerly stood excellent crops of corn are now produced.

RALLS.

Judge I. T. Dawson, Hassard: We have some flat lands that heretofore were considered worthless for cultivation, but since being drained with open ditches are the best lands we have for corn, oats, rye and grass.

J. D. Meyers, Perry: My observations on drainage have been confined principally to flat prairies where the drainage done was in grading public roads, leaving a ditch on each side. The value of such lands has been increased one hundred per cent.

RANDOLPH.

Jas. W. Rucker, Higbee: During the twenty-five years that I have farmed I have drained several tracts of land, and each time a great profit has been realized.

ST. CHARLES.

L. T. Henry, O'Fallon: I have had no experience with drainage, but have observed that the yield is increased fully one-half by this treatment.

ST. FRANCOIS.

S. C. Gassom, Farmington: In Virginia our lands were drained by means of blind ditches. A ditch being dug one and one-half feet deep and covered with a split sapling which, with a system of bedding enabled us to cultivate our wet lands.

ST. LOUIS.

C. R. Black, Price: When bottom lands are drained the yield of hay is almost doubled. For corn, the ground can be broken earlier in the spring, and swampy land has been converted into tillable land by this means.

SALINE.

R. F. Gaines, Marshall: Many of our farmers have been tile-draining, and claim that the increase in yield of the first crop is sufficient to meet the expense of draining.

R. H. Levy, Malta Bend: Our wet lands have been almost wholly redeemed by drainage.

A. J. Tirpey, Slater: I know by observation that the first crop will pay the expense of draining.

Dr. J. F. Wheeler, Herndon: Draining gives good results and will pay one hundredfold. The yield of corn per acre is doubled by draining, and no one here doubts its value.

SCOTT.

Geo. E. Clark, Morley: Our best corn land is what is termed swamp land, and before being drained was utterly worthless.

Isaac Hunter, Morley: I have twenty-five acres in cultivation which produced this year an average crop of corn, but before being drained it was covered with water half the year.

SHELBY.

Jesse E. Bishop, Madrid: I find since I cut two open ditches around a flat forty-acre field on my farm that it dries fully as soon as the most sloping land we have, and the production of the field has been doubled by this treatment.

SULLIVAN.

Jno. C. Schnelle, Green City: In Ohio tile drainage increased the yield about twenty-five per cent. where the soil was porous, but where compact open ditches were the best. I am satisfied it would be equally advantageous in Missouri.

WAYNE.

R. M. Rubottom, Greenville: It has been definitely proved that drainage improves the healthfulness of the climate.

WEBSTER.

P. L. Dodson, Elkland: I found tile draining very profitable in Tennessee, and think it will pay here.

H. N. Moreland, Stafford: It is a positive fact that wet, heavy soils properly drained will produce one hundred per cent. more on an average. Such lands will also become loose and friable and will be much easier cultivated.

WRIGHT.

B. H. Cantrell, Astoria: I have a small piece of flat land on my farm where water stood and it would not produce anything. I cut a ditch across it, and it now produces sixty bushels of corn per acre.

Geo. Taylor, Mountain Grove: I have been draining by means of what we call blind ditches on my farm with very satisfactory results, the increase in the first crop paying for the drainage. I dig ditches about two feet deep and eight inches wide; in these I place timbers, leaving a space of eight inches square at the bottom and covering with dirt. Land treated in this manner will stand a drouth much better than before

BARNS.

There is a very prevalent feeling in the West and in our State that barns are not profitable structures for the general stock of the State.

The secretary does not hold this view, and believes that they are to become a most important and invaluable feature of a higher type of farming soon to set in for Missouri. Drainage has not received so much attention as barns. It is yet to become a common practice in our State. Believing that the time had arrived for pressing upon our farmers the importance of each of the above subjects, the secretary sent out his thousand correspondents, equally distributed throughout our one hundred and fourteen counties the following questions regarding barns.

1. What per cent. of the farmers of your county have barns?
2. Is the disposition to build barns on the increase in your county?
3. Are barns profitable? If so, give any direct facts that you may have to that effect.

An average of all the answers to the first questions is forty-four per cent.

In answer to the second question, three hundred and eleven correspondents reported an increase in the disposition to build barns, to fifteen negative answers, and a majority of the fifteen stated that the lack of interest was due to hard times. A large number of the correspondents failed to answer either way, which accounts for the small vote cast.

Only three answered "no," to the first part of the third question, while but few were indifferent. For replies to the second part of the question, see their notes in the article following.

A quite thorough knowledge of what constitutes a barn, and of the type and amount of barns in the State, warrant the assertion that many of the correspondents wrote under a misapprehension of what may be fairly considered a barn. It is certain that nothing approximating the number of barns reported by many counties exists in those counties. Yet the returns indicate under critical examination that our best farm-

ers believe in barns, and believe in them as the result of their use and of observation. I hope that the observations of those correspondents will be carefully read. Their tenor justifies the practical farmer's attention and further inquiry. The State itself, through its agricultural college, can well afford to investigate this question through practical investigations. Such work will be entered upon when barns are furnished by the State to its State Farm.

A ROUGH ESTIMATE.

In bulletin No. 25, published in this volume, it will be seen that one hundred tons of hay in the stack shrinks 13.2 tons. At $6 a ton gives $79.20. From one hundred tons twenty per cent. will be tramped out in eating from a stack, or 17.36 tons, $104.16. Of the balance, 20 per cent more will be required to maintain the same growth on a steer that would be maintained in a barn of the right sort, or 13.88 tons, $83.32. This last estimate is made with the result of long feeding trials of the winter on the relation of temperature to food comsumption before him.

With a barn having means to save all of the liquid and solid manure saved, it is safe to estimate the increased value of the manure saved at $100.

This gives a total of $366.68. A $1,500 barn will easily protect one hundred tons of hay and the cattle that would be necessary to consume it. This would be nearly twenty-five per cent. interest on the investment.

But this saving by no means represents the full value of barns. Without barns no well organized and high order of farming can well exist in our climate. Our immense waste of fodder in this State cannot be fully utilized without barns, where this food can be controlled and combined in well balanced rations in accordance with the best modern practice and science.

Full crops in this State will never be raised without some means of fertilizing crops. At present yard manure is our best and cheapest source of plant food. As yard manure is the practical measure of our crops, and the amount saved, and not the amount made, that practical measure, it follows that the hope of the future of our farming is very much wrapped up in the question of barns.

Barns, then, are a part, and a necessary part, of good farming.

It is not the purpose of the writer to enter upon the discussion of barns in detail, but to briefly explain the purpose of the full notes on barns that follow, with an added word or two in commendation of barns. At some period in the future it is his purpose to enter upon a full investigation of the subject.

CUTS OF BARNS.

The first cut shown is of a barn designed for the Missouri Agricultural College Farm by the writer, but which will be somewhat changed before construction. The engraver has made mistakes in his cut of it, which came to hand too late for me to have corrected before the printer would need it.

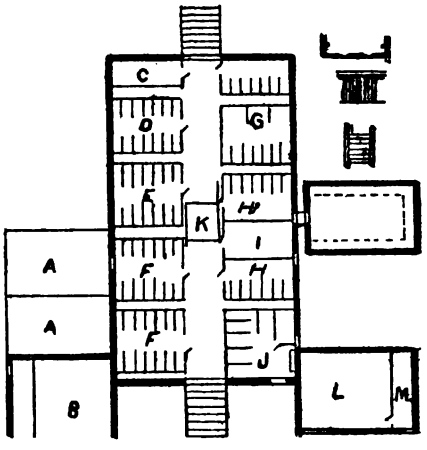


Fig. 1.

It represents a carriage room with floor above, supported from the roof, in order to give a room without posts, that carriages may be arranged around the room. It is 30 by 30 feet. From the carriage room the horse is taken direct to the stable J by a door not shown. M is a tool room, where carpenters' tools, bench and conveniences, invite the farmer at odd times to do much of his own repairs. Here will be arranged the small tools of the farm in systematic order.

NOTE.—Since this cut was made the State has appropriated $6,000 for the erection of a barn and sheds. A careful study has been given to the matter, and a material change has been made. The barn that will be erected is a bank barn, with the cattle stalls in the basement standing on a cement floor. The tool house, engine room and silo are placed in the bank opening into the cattle room. The second floor is used for sheep, horses, granary, wagons and large and small tools, while the loft is used for hay and fodder. As a cut will be given in the future, it will only be added that in the water supply, ventilation, conveniences of granary, tool sections, use of engine for cutting fodder, steaming food, grinding, heating water, saving of manure, and other points of economy of steps and money, it is thought to be very well arranged.

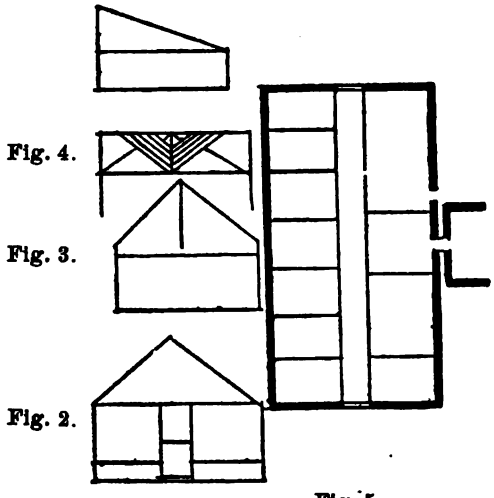


Fig. 5.

Figure 3 represents an open shed with a slight incline into it, so that farm wagons are easily run in by hand or backed under it by teams. It is 22 by 30 feet and will enclose four sets of wagons. It is supported without posts in the center as shown in figure 4. The little unlettered section of this leanto shed is designed for carriages of friends or callers to drive under when calling on business and during rains.

The wagon shed and tool house C and M have a floor above laid two to three feet below the eaves as shown at figure 3. This floor is supported from the roof by a rod in the center. This floor is for storage purposes, for tools, etc. Here by a trap door, or by an opening above, a pulley standing over it at all times, the tools of temporary use are drawn up, oiled and arranged in order in this open loft.

The main barn is 64 by 100 feet or of any length desired. The floor runs through the center of the building which is still as economical a system as any. J represents the horse stall with room behind for grooming, with a closet for harness and a box stall at the right. F, E, D and H, represent stalls for cattle with opening from each to the floor for weighing upon scales K. G should represent box stalls for cows to drop their calves and for temporary use of calves. C is for young calves. Each of those cattle sections open into a yard as shown at A. I was intended to represent a meal and grain room, from which a track ran the length of the barn upon which grain could be run to each stock section. The room is placed in the center of the barn as it saves steps. The line between I and H is wrongly drawn and should be where H stands enabling a free passage from I or the meal room to

the corn room or grain barn. The grain barn shown at the right of F is thus placed that it may have direct connection with the meal and grain room and thence to the center of the barn and so save many steps. The floor shown is the second floor, below is the steam power. The dotted lines mark the corn crib, four feet wide in order to save corn at the close of the dough state.

The corn crib is filled from a third floor above which may be reached from the main barn from the ground or from the second floor. The grain is taken from the thresher of the hay loft of the main barn direct to this third floor of the grain barn with few or no steps. From those reservoirs of grain, filled above, the grain is drawn by a slide from the bottom. These boxes for grain and a system of ventilation of the corn and of getting access to the corn crib at any point of the crib by a system of costless slat-like slides, is not shown in the cut.

The power in the basement of the corn barn runs a small burr mill and sheller on the floor above. Its wire ropes run the thresher and cutter in the loft of the main barn.

The floor of the hay loft need not be shown as it is a plain open room through which to the ventilator above, the ventilating tubes from the stalls run. Down these shafts the hay is thrown to the floor below, doors opening to it at each perpendicular area of the loft above.

On a sloping surface, if it is thought best, a drive way may take one to the hay loft and on steep hill sides I have seen these drives carry the hay into the gable end of the barn, all of the fodder then being pitched down. Now, such a barn is less desirable than formerly, as hay forks and carriers will take fodder from the first floor to any part of the loft. By this means all of the loft is saved for storage.

For this use of the loft, frame work has to be designed especially. The thresher and cutter may still be placed there for work and the passage lead to the corn barn on its upper loft. The basement of the barn should be entirely water-tight by a cement bottom. Thus all of the urine and solid manures are saved—the hope of the farm. Such a cellar must be thoroughly ventilated by shafts above and by windows. The floors above must be tight.

Those who object to cellars will make a section at the end of the barn and run the manure to it by trucks or by the barrow. Fig. 5 was intended to represent the cellar of the barn, but is not drawn as designed, however this makes little difference. It opens direct to the steam power. It may have a root cellar, the base of a silo and if sheep are kept above, below such a section, cattle may be kept. Pig pork is the only profitable pork. This is made cheapest in summer in a cool place. I have received most excellent results by keeping pigs in pens

in summer in the cool basement of a barn. Hence this section is divided into pens for pigs. In winter this section can be controlled and health maintained for the fall crop of pigs to fatten for winter sales. Many will doubt the cellar arrangement. I will not urge the position now but for such will show a ground floor of another, and very economical floor of a barn.

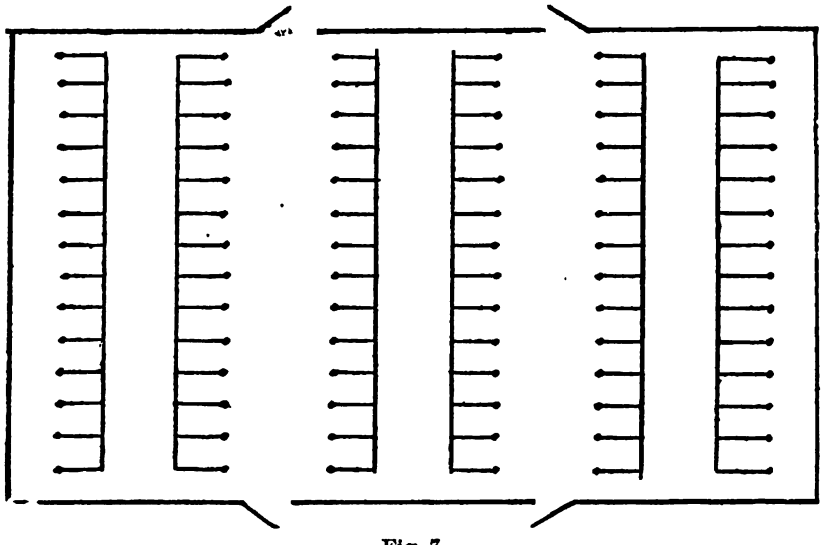


Fig. 7.

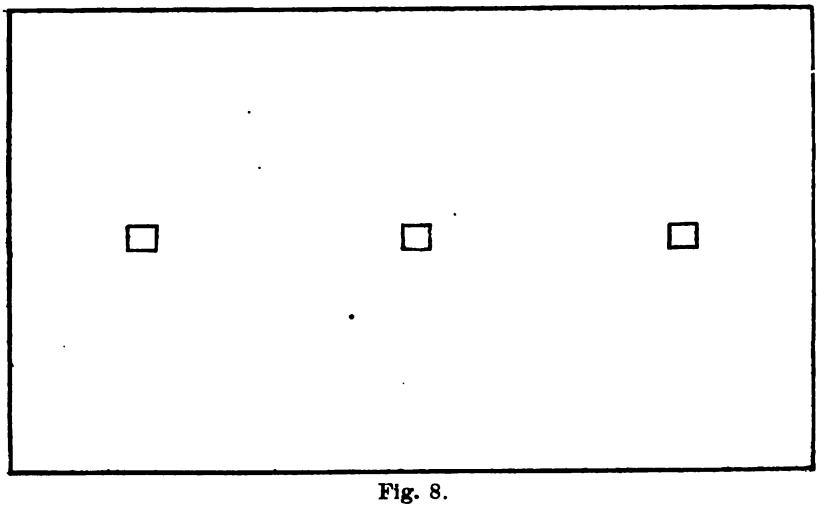


Fig. 8.

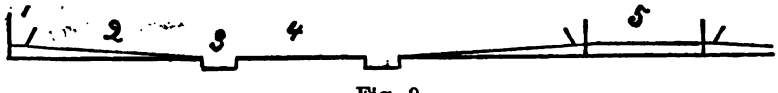


Fig. 9.

Cut 7 represents a very economical barn. Its cattle stalls stand on cement floor, the only internal wood-work will be the stalls and feeding passages. Eight feet above this floor is the loft, Fig. 8. Into this loft the fodder is taken by the horse fork from one end of the barn. Such a building is but a shell, having a minimum of cost and maximum of food and cattle capacity. It is also a very warm barn as only eight feet or the height of the cattle section need extra protection. This area should be boarded by good boards lined with paper and then be overlaid by siding, or by shingles. In it water would never freeze. I confidently assume that it would pay twenty per cent. if made part of an intelligent system of farming.

The little squares within Fig. 8, are the ventilating shafts, down which the hay is thrown to the feed walks below. The barn is 52 by 84 feet. Fig. 9 shows cross section of the floor of Fig. 7, and needs no explanation.

Fig. 11.

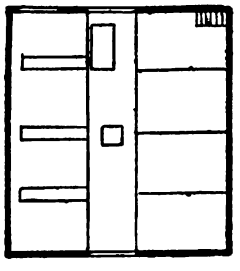


Fig. 12.

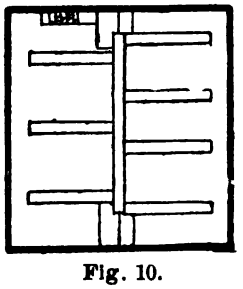


Fig. 10.

Fig. 13.

Figs. 9 and 10 represent the basement and second floor of a sheep barn. Hay is dropped from the upper floor to the feed passages below and grain is drawn by spouts from bins above. Fig. 11 shows the side of feed racks adapted to rams with horns, while No. 12 shows the end section of feed rack. The hopper shown for hay is so hung as to allow hay drawn from it as to shut off seeds from getting in to the sheep's neck, and is pivoted so as to turn out and drop down the outside and prevent the sheep from getting at the racks while feeding grain. The cuts in Fig. 9 that run at right angles to the center passage are racks for feeding sheep and are approached from the main feeding passage. The sheep feed in to the rack from both sides, but not from the end.

NOTES FROM CORRESPONDENTS,

In response to a request that our county correspondents give any direct facts that may have grown out of their experience or observation showing the value of barns.

ADAIR.

Jno. Shibley, Shibley's Point: Barns are profitable for the preservation of feed, care of stock, and health and convenience of the farmer.

Noah Stukey, Millard: Stock come through the winter in better condition when kept in a barn than when fed out of doors. Besides barns are profitable for saving feed.

ANDREW.

Newton Bird, Avenue City: I can give only common sense facts and experience, which is that stock kept under shelter will do on at least one-half the food and make a vigorous growth, while if exposed to the cold and wet they come out dwarfed in size and unprofitable to feed.

S. K. Faulkner, Whitesville: The improvement that has been made in the quality of our stock has made barns a necessity. My neighbor has a barn 40x60 feet with 20 feet posts, and one-half basement, and well painted. But in such barns there is often more expense than adaptation, and I think some cheaper plan would answer.

Jno. W. Laney, Rosendale: Barns are profitable, but I have no positive figures at hand to show how profitable.

Benj. Petree, Fillmore: I have a barn with basement thatI have used for several years. It shelters all my stock and I find that it takes less food than before; can save more and better manure; save my food better, is much less trouble to do the feeding, as I do it all inside without being exposed to the inclemencies of weather. I have both both box and open stalls.

ATCHISON.

R. Buckham, Langdon: Barns are used principally in storing away hay and grains of all kinds for winter use; for protecting horses, cows and young stock against the storms of winter; housing farm implements. No well-to-do farmer can do without a barn.

J. A. Hoon, Watson: Barns save twenty-five per cent. of the hay that is usually lost by stacking in the field and feeding on the ground, and twenty per cent. of the grain raised on the farm can be saved by storing in a good barn. Most of our farmers are building good barns as fast as they pay for their land.

AUDRAIN.

Geo. W. Batterton, Sturgeon: Observation and some experience has taught me that stock of all kinds will do a great deal better on the same amount of feed when sheltered. Or, in other words, it will take less feed to winter stock if sheltered, than when exposed.

W. B. Cook, Laddonia: My experience is that stock sheltered from cold storms will do as well on good hay as out stock when fed on hay and grain. Many make the mistake of turning stock out during the day in stormy weather, when they take cold which results in pneumonia in many cases, but not contagious. Cattle and horses are much troubled with lung complaints which have been brought on by exposure to storms of winter. This is especially true of pregnant animals when their condition creates fever, oftentimes endangering not only the health of the dam, but that of the young which she is carrying, making it comparatively worthless. Stock dropping their young on cold, wet ground in early spring, and during cloudy or rainy weather, or at night when heavy dews fall on the grass, are apt to contract lung complaints, consequently much stock have affected lungs. I have seen cows opened after death whose lungs were decayed, caused by one cold rain. Stock accustomed to shelter should not be turned out for all day in a storm, and all stock dropping young in early spring or at night before the summer time, should have a good bed and shelter. With my varied experience with stock, I have been amused at the pleuro-pneumonia scare. I have seen in bunches of feeding cattle so many that had lungs affected that it was unprofitable feeding.

S. C. Hale, Laddonia: I know that barns are profitable for storing hay to prevent damage while gathering in showery seasons. When a load of hay is dry it can be safely stored and not be obliged to wait for enough for a stack. They also save much that is wasted by feed-

ing on the ground during stormy weather, besides the shelter of stock while feeding the hay. I am satisfied from experience, that an acre of grass cured and put into a barn, and fed there to stock, will keep 100 per cent. more stock than the same stacked and fed in the field. There is a growing interest in improvements of this kind, and notwithstanding the hard times, many good barns are being built this season at a cost of from $400 to $1,000.

Robert T. Steele, Wellsville: Of late years great interest has been manifested in the question of barns, and many good large barns well built, well painted, and many of them on good stone foundations, have been constructed at an average cost of about $500, though some of the best have cost from $600 to $1,000. Capacity from 8 to 20 tons of hay, from 500 to 1,500 bushels of corn, and from 18 to 20 horses. Only a few barns have been built in this neighborhood for cattle. Some of the horse-barns, however, are shedded, and a portion of the cattle are tied up in them; but most of the shelter yet provided for cattle consists of open sheds. Great interest has been manifested in this department of the barn question.

Another question that is closely related to the one above, is that of horns.

A few years ago I concluded to try a plan suggested by a St. Louis paper, which was for the prevention of the growth of horns. I could not induce my neighbors to try it until this year, when the success of the process had been fully demonstrated by the clean, smooth heads of my one, two and three year old cattle. This year about two hundred head have been operated on in this township. The best time to perform the operation is at six or eight weeks of age. The slight protuberance is cut off and a good crust burned on the place with the end of a red hot bolt. It makes no sore, flies do not bother the place, and there appears to be no pain after the application is over with, and but little after the first application of the iron.

The advantages are: Loose cattle are more easily sheltered, they feed better, being freed from that state of nervous excitement caused by constant fear of each others horns, hogs, sheep, colts, etc., are less liable to be injured by them, and a man can keep any breed he desires, and yet enjoy all the advantages of polled cattle. The success of the plan as tried on six months old calves by several buyers, has yet to be proven.

E. C. Waters, Vandalia: Hay and grain preserved in the dry, furnishes more nutriment than that which remains exposed. Stock, of all kinds, well sheltered in severe weather will do on one-third less feed and be much stronger in the spring. Thus, we save on *quality*, feed *quantity* used, and results derived.

R. N. West, Mexico: Barns are profitable as a shelter for stock; as a saving of feed, and as a better place to store feed than temporary cribs and bins; also, a great saving of hay as compared with stacking it in the field. They are also profitable in the saving of manure, as one load of manure taken from a barn is worth two of that which has been exposed to the rains, etc.

BARRY.

W. A. Boucher, Exeter: There is a saving of one-third the feed required for stock if not sheltered; the feed is kept in better condition and retains its nutriment; also, saves the machinery of the farm.

H. S. Montgomery, Washburne: Barns are profitable when we use them for storing away hay and grains, and for sheltering work horses. We use sheds for cattle and mules, which are made with posts boarded up and covered with straw; this is good enough for out stock. Set two rows of posts running east and west, brace with cross timbers, plank up the north side, and cover with straw. In this way you make a cheap and comfortable shed.

BARTON.

Chas. Price, Irwin: Twenty-five per cent. of the hay and sheaf oats are saved by the use of barns; besides the comfort and convenience of feeding stock, the saving of grain, etc.

BATES.

H. Miller, Foster: Barns afford protection for stock during cold weather, and they require less feed when in the barn. Man is less exposed when feeding, and housed grain and hay is more nutritious, retaining their full strength.

Dr. H. W. Tuttle, Adrian: Farmers say that it requires less feed to keep their stock when housed, besides they have a place to store their grain and farm implements, which would otherwise have been materially damaged by the exposure. I think the greatest loss the farmer has to contend with is his neglect of farm implements, as many leave them where last used until again needed.

BENTON.

Henry Mahnkin, Cole Camp: Barns save a great deal of feed and manure, and are profitable for sheltering stock of all kinds.

BOLLINGER.

Jacob J. Conrad, Marble Hill: We recognize the fact that barns are great economizers of feed, both in preserving it from damage by weather, and by its requiring a smaller amount for stock when well housed.

Henry J. Murray, Sedgewickville: Feed stored in barns is better preserved then when stacked in the open field, also stock when housed during the winter look better when spring comes.

Jas. G. Woodfin, Shepperville: Barnes are profitable, and so admitted by all farmers. The farmer who has no barn desires one, those who have barns find that they need more room, and every years' experience tends to convince us more fully of the fact that all the products of the farm should find a place in the barn; while all stock kept on the farm should be provided for and fed in the barn. This course of treatment promotes early maturity in stock and saves a large amount of feed. Most farmers are becoming conviced that a small amount of stock well cared for, is more profitable than a large amount poorly provided for. In all matters of progressive farm improvement it may be truly said, that the majority of our farmers have done well considering their circumstances. But the financial condition of most farmers retard their progress.

BOONE.

W. L. Parker, Columbia: Barns are used mostly for young stock, and cows, mules and horses, while yearling, two and three-year-old cattle are seldom housed. I have never made any experiments on the subject, with a view of ascertaining how much feed would be saved, if any.

Geo. M. Pipes, Rocheport: Barns are profitable in sheltering stock, in preserving the products of the farm, besides making it much easier and more pleasant for the farmer to do his feeding. One might ask if the dwelling house was profitable; if so, the barn is also. A human man is humane to his domestic animals and this always pays. Let him have a barn!

BUCHANAN.

Wm. M. Matney, Platte River: I should think that barns are profitable, yet I am not prepared to give any direct facts to that effect.

But I am inclined to think that stock keep in much better condition, on probably less feed when sheltered than when exposed. They are principally used for sheltering horses, yet some are making and using sheds for their cattle.

Eugene Spratt, Wallace: I consider it a profitable investment for the farmer who builds barns for horses or cattle.

BUTLER.

Jno. Endaly, Shiloh: I have used a barn for thirty five years and find them valuable for storing my hay, oats, etc., and as a shelter for stock, but I do not tie my stock. I think there is great need for barns.

Jas. F. Tubb, Poplar Bluff: There is a great deal of stock in this county, and those who use barns for hay and shelter for stock, save, I think, fifty per cent. in feed, considering the difference in the condition of stock, and the amount of feed saved by using shelter.

CALDWELL.

T. P. Allen, Kidder: The last two severe winters have convinced feeders that it is almost like throwing feed away to feed without shelter, and they are making preparations to care for them better by furnishing a shelter.

Jno. McManagle, Kidder: I think any farmer that has eighty acres of land wastes enough every four years to build a barn 30 by 40 feet, which he might save by using a barn. In fact, farmers are beginning to feel the need of barns in this county, and many have built barns this year ranging in cost from $400 to $1,200. The basement is generally used to tie stock in, and the upper floor for storing away hay.

Rev. D. W. Monroe, Kidder: Barns save much feed and are needed for the protection of stock of all kinds during the winter. For profit, one had better have a good barn than a good house.

Jno. Sigman, Hamilton: The hay through this country was damaged very materially by the rains which came while the stacks were warm, the straw taking water very badly. The more barns the better the hay will be preserved and the more stock we can raise on the same amount of feed. Hay that is kept in a barn is worth twenty-five per cent. more than that which has been stacked in the open field.

D. C. Wells, Catawba: Several of the largest barns in this vicinity are used for hay alone, but most of the barns are used for hay and horses. Very few have been built for cattle or sheep; yet this county has as many barns as any other of its size in the State.

CALLAWAY.

J. L. Erwin, Fulton: Four new and very fair-sized barns are now being built in my immediate neighborhood, and they will be ready for use this winter.

P. B. Gingrich, Fulton: Barns built on the right principle, well ventilated, are without a doubt both profitable and labor-saving. I think that an illy-ventilated barn for stock is worse than none, causing disease among the stock. For storing hay and other provender barns are especially profitable, the nourishing qualities and aroma being retained, while if stacked in the field much of it is lost. As my space is limited, I will conclude by saying that I rejoice to see the interest taken in this county in improved barns, etc.

R. O. Humphreys, Guthrie: They certainly are profitable, for those farmers who have good barns have good stock and good farms, while those who have none generally have little else.

Jno. D. Jolley, Millersburg: There are very few farmers that have extensive barns, whilst nearly all have stabling for a few horses. The cattle, hogs and sheep are exposed to the inclemency of our hard winters, and as a consequence consume from one-third to one-half more feed than those which are sheltered.

CAMDEN.

Wm. F. Claiborne, Decaturville: I consider barns very profitable. I kept about twenty-five of my calves sheltered during the past winter, and I found that they came out in the spring in better condition than a like number for which I had no shelter, yet the sheltered lot ate at least twenty-five per cent. less feed. There is in a barn less waste of hay and corn fodder, and it can be fed cheaper, being easy of access in stormy weather. Most barns in this county are built on a cheap plan, it being a timbered county. They are fixed for cattle to run loose in, built high enough for hay above.

G. C. Thornton, Cape Galena: Barns are a great advantage to farmers to store grain in and to make shelter for stock. I have tried it to my satifaction and known that if farmers would build barns to shelter their stock they would save much feed.

CAPE GIRARDEAU.

H. Bruihl, Oak Ridge: Barns are profitable in storing hay, oats and other feed for stock, also in protecting stock in winter. Stock will do better on the same feed if sheltered from the wind, rain and snow

during the winter, cows will give more milk dnring the winter, and more manure can be saved, which is of much value in increasing the crops of the farm. Manure, when properly applied, will give good returns, and will increase the yield of even our richest bottom lands.

D. R. Cowan, Millersville: All products of the farm are better protected from waste and decay by being stored in a barn. Stock protected from the inclemency of the winter require less food to keep them in good order and health; manure can be better collected and preserved.

CARROLL.

W. T. Mayfield, Roads: The building of barns has been embarrassed by the hard times. Some of our farmers have constructed barns for cattle feeding, an apartment for hay and corn and stanchions arranged for sixty or eighty head of cattle. To make the business profitable through the winter season, many others will, I think, have to make similar preparations. The barns referred to above were built at a cost of from $500 to $700.

F. M. Marshall, Norborne: Barns are profitable for the following reasons: First, by sheltering stock you will save about one third of the amount of food; second, stock will come out in the spring in better condition; third, stock will be more healthy when well sheltered.

Marion Shirley, Bogard: Barns are profitable, both in the saving of grain and the protection of stock from the cold, storms and rain.

CARTER.

D. L. Massie, Pike: My experience with barns is that they are very profitable. I consider that it does not require over three-fourths as much feed to winter stock in a good barn as when they are exposed to the weather.

A. J. Patterson, Lee: Barns are profitable for sheltering stock during the winter, as they come out in the spring in much better condition than when exposed. The average capacity of our barns is from ten to fifty head of cattle, the larger ones being fastened on one side and the younger cattle to run loose; average cost, from $500 to $800.

Jos. B. Stephens, Freeland; Barns are as profitable for sheltering feed and stock in this latitude as anywhere, as the cold rains and soft snows weaken the stock if exposed; therefore barns pay.

CEDAR.

John W. May, Virgil City: To show you the profits of shelter, I need only refer you to the thrifty farmer who has good shelter for his

stock. The stock will have nice, smooth hair, look thrifty and healthy, while on the other hand, when you look at the horses that stand out all winter, you see them covered with long hair and a scurfy hide. The cost of the barns of this county is from $100 to $500, with an average capacity for hay of from one to five tons, and the profits from their use, twenty-five per cent. on the investment. Our barns are used almost exclusively for horses, not one cow in fifty getting shelter during the winter.

William R. Williams, Humansville: I find by experience that stock of any kind require less food, do better, and come out in the spring in better condition when sheltered than when allowed to stand in the open air all winter. When you show me a man who has a large barn, I will show you a man that is prosperous, has plenty to go on, and always has something to sell. It is the man who has nothing to sell that complains most of hard times.

CHARITON.

John Bayne, Hamden: Barns are most certainly a profitable investment, if anything on the farm can be classed in that category at the present time. They are a necessity in our variable climate, and can be most profitably utilized in housing horses, mules and cattle, tied in stalls on dirt floors, with hay in loft above, thereby saving labor in feeding; also, in saving manure in proper condition to be again returned to the soil, while the animals and those in attendance on them are not exposed during very bad spells of wet and snowy weather.

James Sanderson, Malcolm: For the last eight years I have cut and stacked from one hundred to one hundred and fifty tons of hay annually in Cook county, Illinois, and, although I am considered a very good stacker, I consider my loss in damaged hay would average twenty per cent. The last two years I staid in that county I had the use of a hay barn that cost me $150, and held eighty tons of hay. At the end of the two years I sold the barn for $75, and it paid me well at that, as it saved me more than $1 per ton on the eighty tons it held. I would advise the farmers of Missouri of moderate means to build hay barns large enough to hold all of their hay and most of their corn fodder, straw, etc.—say from forty to one hundred feet long and thirty feet wide for hay, with a leanto one ach side for cattle, horses, etc. The posts should be set three feet in the ground and extend twenty feet above. The hay, etc., can be fed very conveniently and with little waste. Such a barn one hundred feet long, with a leanto on each side, with a shingle roof, doors and hay carrier, can be built for $500, where the posts can be furnished on the farm. The use of such a barn will be

well worth $100 per year, and I am satisfied that farmer can afford to pay even twenty per cent. for money, if he invests it in such a structure. The above will be found a very economical plan, as the leanto acts as a substantial brace for the main building,

George W. Stowe, Rothville: Barns enhance the value of property, protect stock and farming implements, save feed, and show thrift and prosperity.

CLARKE.

Hosea Stout, Winchester: By the use of barns we save one-fourth of the feed required by the same number, if allowed to stand out, as many of our farmers do. I think there is less danger in feeding cattle when tied, besides they get their own food, and each one gets its share.

CLAY.

W. H. Arnold, Kearney: Our most enterprising farmers are greatly interested in the suject of barns. The great loss of stock sustained by exposure to the inclemency of the weather, and of hay by stacking hay and grain in the field, has caused many farmers to investigate the matter. The conclusion reached in all cases is, that a well constructed barn will save its cost in a few years. It is estimated that an animal when sheltered will thrive better on one-fourth less feed than the same animal would if exposed to the weather. In this township we have a number of thoroughbred short horn cattle, and they are invariably furnished with comfortable stalls in good barns. At least twenty per cent. of all the hay and grain can be saved if fed in good barns, this waste being caused by our careless way of feeding on the ground.

Samuel Dooley, Barry: With what experience and observation I have had, I conclude that those who had barns during the cold winter of 1885 and 1886 kept their stock on at least one-third less food, brought them out in the spring looking sleek and in good order, with smooth hair, whilst those that were not sheltered looked bad and consumed more feed. There is, therefore, a move in the direction of building more shelter for stock.

A. B. Crawford, Smithville: Barns are profitable, both in saving much feed and labor, and are much more comfortable for stock.

CLINTON.

John Althouse, Turney Station: A barn will pay ten per cent. on the cost in the preservation of hay and care of stock, I built a barn two years ago 32 by 64, corn crib 8 by 50, and stalls for eight horses

and eight cows. I could not do without it. A Dutchman always builds a barn first and afterward a house, as the barn helps to build the house.

George Ditmars, Turney Station: I went without a barn myself for five years, but I have used one for the last five, and I can see the profits of barns very clearly.

E. C. Hale, Sr., Turney: Barns afford comfort to our stock, and there is, consequently, a great saving of feed. Stock are more healthy and it is much more convenient feeding. Besides, there is a great saving in housing grain and provender, more satisfactory to both man and beast, and more money made by their use.

James Williams, Cameron: A very expensive barn, in my opinion, is not a profitable investment, but every farm of one hundred acres or more should have at least a small barn, besides good sheds for sheltering stock of all kinds during stormy weather. I think good stock sheds are more profitable in proportion to their cost than expensive barns. Notwithstanding this, I think a good barn pays, where the farmer is able to build it without encumbering himself with debt. It is better, however, to make a debt in building a good barn than a fine house on a farm, but better to be clear of debt. A good, roomy and well planned barn is a good place to do hundreds of little things during wet or stormy weather, which would otherwise have gone undone, besides the comfort to stock, saving of hay, manure, and improvements. So build the best barn that you can pay for, brother farmers, is the advice of one who has lived in Missouri for over fifty years and forty years on the same farm.

COLE.

John Carender, Brazito: My experience with barns has shown me that hay when stored in a dry barn will keep sweet for a number of years, while on the other hand, when standing in the field in stacks, it depreciates in value and soon becomes worthless. Stock require less feed when comfortably housed.

Elias Elston, Elston: Yes barns are profitable because you violate no law, human or Divine, in sheltering your stock from the cold blasts of winter, while you do violate the laws of God and man when you are cruel to your animals. The terrible disaster on the Western plains last winter is a good illustration of this. The question, does it pay? has, I think been settled many years, by common consent, for a barn of some kind is regarded as indispensable to a farmer. It is claimed by practical farmers that fifty per cent. of the feed is saved by keeping stock through the winter in a comfortable barn. Almost every farmer in this county has what he calls "the barn," yet first-class barns are

not very common; indeed, one to every twenty five farmers would be a full average for this kind of structure; buildings for instance, that cost from $1,500 to $3,000, with capacity for fifty head of cattle, ten head of horses in the basement, and grain bins, hay mows, etc., above. The necessity for a barn of some kind is so very apparent that every one has something of the kind. Whether barns are profitable or not, you know that we are apt to judge a man's ability as a farmer by the quality and condition of his barn, in the same manner that we would rate the advancement of culture and refinement in a given community by the condition of the public roads of that vicinity.

H. G. Hamilton, Jefferson City: Barns are profitable in a great many ways, such as in housing stock, sheltering hay and grain. The average cost of the barns of this county will be between three and six hundred dollars, with a capacity of from ten to twenty tons of hay.

COOPER.

Thos. A. Bear, Boonville: A farmer that allows his stock to stand out and take all kinds of weather can never thrive in this country. This is one of the most direct facts that I know of showing the advantage and profits of a barn.

S. L Jewett, Clarks Fork: I find by actual test that cows kept in a comfortable barn will give more milk and keep in better condition on the same amount of food, than when left shivering in the cold and wet in the open yard, also that sheep do better by having a shelter to go under during storms, or when the sun is verry hot in summer. In fact, any stock will show the effects of comfortable quarters during the winter. Our farmers are not, as a general rule, sufficiently alive to the importance of building large barns to give all their stock shelter. Some of our cattle feeders find it profitable to have sheds to feed cattle in, and allow them to go under during storms, while loose in the field, but I am satisfied they would find it more profitable if they kept them in warm quarters during the cold weather.

DADE.

W. T. Hastings, Everton: Barns are profitable for the reason that they save about one-fourth the feed required for stock when not housed.

Wick Morgan, Dadeville: Barns save one-third of the feed otherwise required, besides it is humane to your stock, and you save enough manure to pay for fully another third of the feed.

S. E. Shaw, Dadeville: Those who have barns have better stock. The reason for this is, their stock is not exposed to the snows, cold

rains and winds which are so common in our locality. A barn costing $200, to an average farmer is worth twenty-five per cent. of its cost each year. Many cattle and hogs die for want of shelter, besides the number of pigs and lambs that die from exposure or lack of protection.

DALLAS.

Frank Fowler, Buffalo: Barns save feed and retain flesh already made. The barns of this county vary in size from a 12 by 14 log stable, shedded on the sides, to a frame structure 40 by 60 feet.

A. G. Jones, Louisburg: Barns are profitable because they shelter stock from the cold snow and rain of winter, and save feed to a great extent.

DAVIESS.

A. Allen, Jr., Kidder: For dairy farming and raising blooded stock barns are an absolute necessity, but for the common farmer who is raising young cattle and colts, a cheap lot of sheds will give better satisfaction. In case you use sheds you will not crowd the stock together so badly as when large barns are used.

E. R. Chubbuck, Kidder: There is no question in regard to the profits of barns. It is shown very plainly in this county by the men who have plenty of barn-room for their stock. Their stock are in better condition, sell for higher prices and their farms are in a higher state of cultivation. If the farmers are compelled to sell at the present low prices they must have plenty of shelter.

J. B. Scott, Jameson: Barns are a real benefit to farmers in saving hay. Much of the hay in this county is stacked in the field, and at a low estimate, ten per cent. of it is damaged or worthless. Again, a barn can be shedded so that all the stock will be housed, which is a great saving of feed.

DEKALB.

Isaac V. Moore, Haydonville: I consider a barn the most important fixture on a farm, and no farm is complete without one. It is a great saving of feed to have it well stored under cover and shelter for stock in winter.

DENT.

B. A. Hedrick, Talladego: The average farmer wastes enough feed in four or five years, by stacking his hay, corn fodder and oats in

the field, to build a good barn, to say nothing of the loss by his stock having to rough it.

A. P. Kerr, Salem: I changed farms last fall, leaving barns and sheds and my stock suffered greatly from exposure. It will take at least one-third more feed to winter stock without barns and sheds, and it is very hard to keep them in living order with all the feed they will eat, I found it so last winter at any rate.

DOUGLAS.

W. H. Brown, Arno: A good barn not only saves at least ten per cent. of feed by protection from waste and weather, but it requires ten per cent. less feed for the stock. I know a man who keeps from one to two hundred head of cattle in a barn 60 by 60, shedded on two sides, and that barn has paid for its self in four years. The manure which was formerly lost, now affords a coat for ten acres of grass, thereby increasing the yield twenty-five per cent. Cattle wintered in barns are ready for market one month earlier on grass than when allowed to stand in the open air through the winter, and calves can be weaned one month earlier and come through the winter in as good condition.

A. Clinton, Florrilla: There is no improvement more profitable on the farm than a good barn. They are profitable because first, they afford protection for stock from the changes of weather; second, for the safe keeping of hay, grain and other foods required for stock; third, the convenience in feeding during wet or cold weather; fourth, the saving of manure and other waste matter to be returned to the soil. Experience has taught me that stock well sheltered in a good dry barn are not one half as hard to keep in good condition as when subjected to the rigors of our northern winters.

James Coats, Vera Cruz: Barns are profitable because they keep stock dry and protect them from the winter winds, though they are not as advantageous here as on the prairies.

DUNKLIN.

E. J. Langdon, Cotton Plant: Barns are profitable for the reason that for the want of plenty of room for our fodder, hay, etc., we allow much of it to be wasted. Very few of our farmers tie their stock and sheds are used more extensively than stalled barns.

FRANKLIN.

H. Calkins, Shotwell: Barns are profitable in every point from which we can view the matter; in comfort to man and beast, in saving

feed and manure. Our facilities for building are unsurpassed by any county in the State, and I am happy to say that our farmers are taking more interest each year in this work and taking advantage of these opportunities to build. This industry has advanced so that the "big-red barn" is becoming a noticable feature of our rural landscape. Cattle are nearly always tied in stalls, occasionally however, roomy box stalls are used for cows and young calves.

Geo. H. Ross, Labaddie: I think one-fourth of our feeds lost by not having barns to secure it from the weather, and also the waste in feeding stock without shelter.

Jno. Schiller, Union: Barns are very valuable; first, in storing fodder of all kinds away; second, in sheltering stock in winter; third, in keeping farming implements in the dry when not in use.

J. H. Schweer, Shotwell: I have a barn 36 by 60 where I can store enough hay to last eight horses and from twelve to fifteen head of cattle twelve months, and I find it profitable.

E. E. Steines, Oakfield: In this neighborhood all stock is housed in winter. Barns are generally of a capacity to hold from two to four head of horses or mules, two to six cows, and the feed required for their keeping during the year. Barns are mostly built of logs with large sheds attached, but the later ones are frame. In most cases, no cash expense is incurred except for material, as the farmers and their sons build most of the barns themselves during leisure time. A barn to hold ten to fifteen head of stock would cost about $150 to $200 besides the labor done by the owner. Barns are certainly profitable, as it requires much less feed to keep stock in good condition, but as farmers seldom keep accounts, it would be a very hard matter to say how much is saved by their use.

GASCONADE.

Simon Boeger, Bay: Barns are profitable for sheltering stock feed, machinery, etc.

August Rick, Hermann: Barns save hay, fodder, and keep stock from freezing and they will be in much better condition when spring comes.

GENTRY.

Geo. D. Burton, King City: The saving in grain, hay, etc., will easily pay for the barn while the advantage of protecting stock and implements will be a clear gain and gradually leads to the improvement of both.

A. W. Darling, Stanberry: Barns are a source of comfort to stock and bring stock out in the spring in better condition on less feed. Besides I feel better with my stock tied in a barn when the thermometer is twenty five or thirty degrees below zero, than when they are standing by a wire fence for shelter.

H. C. Williams, Ford: The unanimous verdict is that they pay a good interest on the investment. I know of no barns used to tie cattle in, and when barns are used for cattle they have a basement, open on the side to give stock access to the lot where they are usually fed.

GREENE.

J. F. Brooks, Republic: The barns of our county cost from $200 to $1,500, mostly constructed with a view of tieing up stock and with a capacity for hay of from five to forty tons. The gain in time of putting hay or grain in barns over stacking in catchy, unsettled weather and the saving of the same from exposure, will pay not less than fifteen per cent. on the investment, while stock will winter, when sheltered, at least ten per cent. cheaper than when exposed. Again the convenience of shelter for loaded wagons from sudden storms and the various odd jobs that may be done during rainy weather in a barn, such as oiling and mending harness, etc., etc. Then the comfort and convenience of caring for stock under shelter, the satisfaction of seeing every animal contented and each having its own share of the feed is another item of no little value. Finally, to sum up, I would not do without a barn in any season no more than I would do without plenty of feed and water for my animals. It is true it requires some extra labor to tie the stock and clean the stalls but there is no doubt that the amount and quality of the manure made over the other method, if properly applied, will more than compensate for all this extra labor.

GRUNDY.

J. Barnes, Edinburgh: The advantage of barns is in protecting grain and hay from the weather, hence, they save a large per cent. of feed and labor.

J. W. Robb, Corneau: Barns save grain, feed, stock and farm implements.

HARRISON.

J. M. Bryant, Bethany: I know of many farmers who raise enough feed for their stock each year, but for want of a barn to preserve it, are compelled to buy before spring or allow their stock to starve.

HENRY.

H. A. Clark, Shawnee Mound: Stock require less food during the winter when sheltered and are worth more in the spring. We care more for sheltering stock than for storing grain, yet I consider a barn profitable even for storing grain.

D. E. McBride, Garland: A farmer built a barn at a cost of $1,200 three years ago and says he has saved the cost of the barn in that time by sheltering his grain and beef cattle.

HICKORY.

A. W. Brownlee, Quincy: Every man of common sense will build barns to shelter his stock.

J. M. Gentry, Quincy: Experience has taught me that it takes about one-half the feed to keep stock when sheltered, that is required for stock when exposed.

M. N. Neihardt, Hermitage: Protection to stock will enhance their value for spring sales at least twenty per cent. besides the saving of feed which is a large item.

Valentine Steber, Quincy: Barns are twenty-five per cent. better than no shelter.

HOWELL.

T. M. Christain, Mountain View: It requires less food for stock when barns are used and the loss is less. Our greatest gain is by keeping stock dry in cold, rainy weather. Some of our barns are made to tie cattle in, but I prefer the loose way, as much less labor is required.

IRON.

J. R. Adams, Goodland: Stock kept in a barn in winter will do better on less feed and be better fitted for spring market. Hence the farmer makes from four to six dollars per head on his cattle and from fifteen to twenty dollars on each mule or horse by sheltering.

W. W. Heywood, Ironton: A barn will pay for itself in three years on any farm. I built a barn twenty years ago on this farm, 30x40x12 feet, at a cost of $200. Lumber was then $2 per M. Ten years ago I added sixty feet more to the west end at a cost of one dollar per foot, or sixty dollars. This barn has paid for itself and has enabled me to build a good two-story house well furnished. All my cattle, sheep, hogs and horses are housed in winter, and everything I

raise on the farm is stored under cover. Every farmer in Iron county who has no barn, or simply a log stable, loses each year one-third the cost of a good barn.

J. W. Lashley, Belleview: Barns are profitable; first, in saving labor in securing crops; second, in the better preservation of crops; third, in the better protection of stock and consequent annual increase of farm products. In short, a well built, judiciously arranged barn of the proper relative capacity for storage of grain, hay and other stock-forage will pay ten per cent. on the actual cost thereof.

Jno. S. Luthy, Edge Hill: A barn will pay for itself in a very short time. Two-thirds of the feed usually fed without barns will go further when fed in barns, and stock will do better than if the whole amount has been fed in the open air.

JACKSON.

J. A. Clements, Hickman Mills: In saving all kinds of feed, the ease and comfort in feeding and the advantage to stock, which are always in better condition when fed on the same amount of food, is good evidence that barns are profitable. It is my opinion that a man will save twenty per cent. on the amount spent for the construction of the barn. I have never known a man who had a good barn to sell his farm and buy one without a barn without building at once.

JASPER.

Sheltered stock require less food and are less liable to disease especially lung troubles.*

JEFFERSON.

W. S. Jewett, Crystal City: Barns are certainly profitable, as those having used them will not do without them, and those who have none want them and will build as soon as circumstances permit. This inclination to build is quite general, and decided improvements will be made in outbuidings soon.

H. P. Funk, Danby: It does not require so large a quantity of provender to winter or fatten stock when housed.

JOHNSON.

Wm. Mohler, Warrensburg: Hay stacked in the field loses about twenty-five per cent. in damage by rains and absorbing moisture from

*The crop circular containing the above note was returned with no address.

the ground. The barn saves this percentage of loss, besides a great deal in having feed at all times dry and in the best condition to feed. Stock fed in a barn require less food to fatten or keep them in good condition. Some of our farmers think their barns save their first cost in two years's time.

J. B. McGirk, Chilhowee: The following are my reasons for believing barns to be profitable: First, because of their convenience in feeding hay and grain; second, for the shelter they afford to horses and cattle; third, because of the warmth afforded to stock of all kinds, thereby saving much extra feeding of grain; fourth, it affords a ready shelter for hay, corn, wheat and farming implements of all kinds (and a good place for hens to lay eggs), and in my opinion wards off chicken cholera to some extent.

KNOX.

Wm. Anderson, Plevna: Barns are valuable for protecting stock, hay and all kinds of grain. I have been using one for four years and feel as though it would be impossible to get along without it.

Dexter Botts, Novelty: Observation teaches us that barns are profitable, and we can look over the county and compare the stock that has shelter with that which is compelled to rough it, and we are bound to admit that the balance is in favor of the sheltered stock. Barns are not only valuable for the protection of stock, but for grain and farm implements they are equally valuable. Show me a farmer who has no barn or shed and I will show you a sloven farmer.

LACLEDE.

Jno. T. Quinn, Richland: Barns are a source of profitt to any stock owner, but especially are they valuable for sheltering horses and cattle. One thing I have noticed is that the farmer who keeps his stock in the barn during the winter has more feed in the spring and his stock is in better condition than the man who allows his stock to stand out. Stock can be taken through the winter with the aid of a good barn on one-half the feed otherwise required. The farmers have taken more interest of late in building barns than in building the dwelling.

Jno. W. Smith, Conway: The farmers who winter their stock in barns bring them through on less grain and in better condition than those who have no barns; stock will winter on one-fourth less feed and be in better condition by twenty-five per cent.

Chas. V. Taylor, Bradfield: Our barns save one-third the feed and stock come out healthier and in better condition.

LAFAYETTE.

J. T. Ferguson, Bates City: Barns are most assuredly profitable for the protection of hay and grain from destruction by the elements, the comfort and protection to farm animals and the saving of seed and manure.

Henry Miller, Concordia: Barns are profitable in many ways. Very little hay is lost in harvesting, even if the weather should be unfavorable, provided you have the proper arrangements. In feeding stock in barns it is done with pleasure, while if fed on the outside it is often poorly done and much feed is wasted.

Rufus Young, Lexington: Barns are profitable because they afford shelter and lessen the amount of food required by those not warmly housed.

J. Garland, Corder: Barns are considered very profitable for protecting stock and economy in securing feed. I believe it is an undisputed fact that stock well sheltered will consume about one-half the feed required by those exposed to bad weather.

LAWRENCE.

E. S. Allen, Mt. Vernon: I had a neighbor on Spring river prairie who had barn room for all his stock, and I am satisfied they wintered on one-half the feed that I used without shelter, and his cattle came through in as good condition as mine.

J. R. White, Verona: A barn will save enough in the quality of hay alone to pay interest on the investment, besides the benefits of saving feed by sheltering stock.

LEWIS.

Leonard Ford, Williamstown: All the produce and implements of the farm are kept dry and ready for use when sheltered, and barns afford a warm shelter for stock in winter, and are a great conveinence.

A. M. Green, Canton: Experience has led me to the conclusion that a barn will save fifty per cent. on the investment.

A. C. Levengood, Deer Ridge: My barn housed twenty head of cattle last winter, which saved me one-third the feed usually required.

W. H. Wallace, Lewiston: I built a good barn last year in which I put about fifty-five tons of hay, some grain, and will shed about forty-five head of stock. The stock I put in the barn last winter came

through in most excellent order with very little grain, while stock that took the weather came through very thin. The barn paid me a very liberal per cent.

LINCOLN.

A. F. Downing, Auburn: I have had some experience in feeding after the old styles with about the same objection to each of them, viz.: Exposure of stock to the snows and blasts of winter, waste of feed and gorging of stock. I have had no little experience with feeding in barns, and it has been highly satisfactory, obviating the three great objections just named.

Fred L. Jabin, Wright City: Barns are especially valuable for sheltering stock during the winter months.

Finley Wallace, Brussels: A good barn is as essential to the success of a farmer as good soil. Good thrifty stock is one of the financial secrets of farming and it is foolish to think that we can have good, thrifty or profitable stock without we take good care of it. In such a climate as we have in Missouri I cannot see how a farmer can succeed without a good barn. Make your barn as roomy and convenient as practicable.

LIVINGSTON.

Jas. L. Boyle, Muddy Lane: Securing grain from the weather and stock from cold rains and winter storms will readily save one-fourth feed and stock will do much better.

L. H. Christian, Spring Hill: We can't do without a barn for our stock and grain.

J. E. Jackson, Chillicothe: I have built a great many barns in this county, and when I ask those men who have good barns if they pay, they all agree in saying they have no money investment that pays better. I know my stock do not require as much feed, look and do better and are more profitable for milk and butter, and my horses will stand more work when sheltered than when exposed. I am also sure that my feed is not wasted as badly and that it is much pleasanter to attend to young stock. The cost of our barns varies from $200 to $1,000. Some are intended to tie stock in while others use stanchions, which are becoming quite popular.

H. V. Lewis, Hale: I cannot give you any direct facts showing the profits of barns, but think they are the best part of the farm. I could not do without them, and they undoubtedly pay a large per cent. on the investment.

McDONALD.

R. B. Montgomery, Rocky Comfort: If farmers would shelter their stock they would find they would come through in much better condition and with less feed; besides it would certainly be better to put all grain raised on the farm in a good dry barn instead of leaving it in open bins exposed to all kinds of weather.

MACON.

T. Jones, Economy: Barns are certainly profitable in saving hay and protecting stock.

C. W. McJilton, Atlanta: Barns are as necessary as the dwelling. Observation in farming shows that where there are no barns, farming is a financial failure.

L. P. Riley, Ettle: Our people consider the barn of first importance and calculate that a good barn will soon build a good house. We claim that a man had better pay fifteen per cent. for money to build a barn with and live in a common dwelling than to do without one. The barn is to feed and stock, what the house is to the family, viz.: A place of comfort and protection. The exact worth of a barn is hard to determine, but we do not consider a farm well equipped until it has a barn.

MADISON.

Jacob Lutes, Marquand: Barns save about fifty per cent. of the feed required for the same amount of stock when exposed.

MARIES.

M. Williams, Maries: I have several reasons for considering barns profitable; first, in storing up the forage crops of the farm, thereby protecting them from the storms which are very destructive to these substances; second, it requires only about one-half the food to maintain your stock when in these comfortable quarters; third, all the manure that accumulates can be stored away until the farmer is at leisure, when they can be hauled to his fields, whereas if he had no barn the manure would be wasted, being scattered about and all the substance washed out; fourth, the feeding, care of stock and storing away of the manure can be done in bad weather without exposure to the farmer.

MARION.

Jos. Adams, Benbow: One fourth of the feed is saved by using barns, besides the manure saved will compensate for the extra expense of building barns.

MERCER.

Jas. S. Taylor, Saline: Barns are certainly very profitable as they are comfortable for stock and save feed. There is no need for wasting feed in a barn, and the manure can be better saved and cared for, which is quite an item. There are very few cattle barns in this county. I use stalls for my cattle and I find it pays.

MILLER.

N. J. Shepherd, Eldon: It requires considerable less grain to winter stock if provided with good warm quarters. The feed is saved in a better condition, there is less waste and manure can be saved to a better advantage, all of which will add to the profits of the barn.

MONITEAU.

Wm. Reidmont, Tipton: Barns are profitable and the farmers are putting up large and substantial buildings to protect their stock as fast as they are able.

R. Q. Roach, California: Barns are not as profitable here as in colder latitudes, still much advantage is obtained from barns in extreme weather, also in keeping grain and hay fresh.

MORGAN.

C. C. Marriott, Stover; Barns are very profitable in this locality, and the barn boom is very much on the increase.

J. D. Parsons, Syracuse: They they save twenty-five per cent. of the feed required. Stock will be in better condition and the manure will pay for building.

B. R. Sanburn, Search: Can only give my experience and observation, and from that I would say that barns save from ten to fifteen per cent. of the feed by protecting it from the summer and fall rains, that is, hay, oats, etc. Again, there is a saving of at least twenty-five per cent. of the feed by animals being fed in dry barns where they can not waste feed, and they are protected from the cold winter storms. So to

sum up, I am convinced that good barns save one-half the food needed in wintering stock, to say nothing of the great profit in sheltering farm machinery, and their increased facilities for saving and utilizing manure, the cheapest and best food that we give our exhausted and hungry soils.

William Wendleton, Atkinsville: We can winter our stock on less feed and keep them in better condition, besides we get the benefit of a large amount of manure for our land. On the whole they pay well.

MONROE.

W. S. Forsyth, Strother: For the past two winters comfortable barns have been a necessity for the preservation of the lives and limbs of young stock. Fully fifty per cent. of the lambs that were dropped in the open air during the past two winters have died. Many calves died, even yearlings have been frozen to death, or had their limbs and feet so badly frosted that they were of no value. Barns pay in many ways. In comfort and growth of animals, convenience to the farmer and saving feed. I have a barn that cost me $1,200, and I have no reason to regret having spent it in that way. Every farmer should have a barn.

T. P. Vaughn, Paris: I kept thirty calves in a barn last winter, and they came through in fine condition without grain. The result would have been different had it not been for the protection afforded by the barn.

MONTGOMERY.

A. W. Hathaway, High Hill: Shelter for stock is very necessary, and while expensive barns may not be good economy, I consider money well spent when used in the construction of good barns.

NEW MADRID.

William Riley, New Madrid: Barns are very profitable for saving feed, etc..

C. C. Thomas, Point Pleasant: I have noticed for several years that stock kept in good barns in bad weather looked much better, are healthier, and fewer die; besides, there is twenty per cent. of your feed saved by using barns.

NEWTON.

Jasper Buzzard, Racine: Barns are very profitable in saving grain and feed, besides they are a great help to stock.

George Hatzfeld, Neosho: I can save twenty per cent. by sheltering my stock in a good barn.

NODAWAY.

M. B. W. Harman, Pickering: Barns protect both stock, feed and tools, and no good farmer will do without one. I have a barn 68 by 111, with 28 foot posts, and over 30 by 45, with 16 feet posts, and still I want more barn room.

OREGON.

Benjamin Gum, Alton: I find that my horses do better from November the first to the first of May in a barn than in the fields My hay and corn does better under shelter than in the stacks and shocks in the field, and it agrees with my feelings better to have my feed in the barn during cold, snowy weather. There is no excuse for a man not having a barn when lumber can be had for from one to eight dollars per thousand.

A. J. Hall, Alton: Stock do better when fed out, hence barns are profitable.

T. M. Simpson, Wilderness: Barns are profitable for protecting stock from the cold rains and snow. They also save feed and enable the farmer to bring his stock out in better condition, with less trouble and exposure.

OSAGE.

C. H. Dallas, Chamois: Barns are profitable in many ways. First, in saving feed; second, in comfort and convenience of feeding; third, stock go out in the spring in better condition, are less liable to disease, and lose less growth in changing from dry food to grass, and vice versa.

W. A. Ferguson, Chamois: With barns you save one-third the feed and have better stock.

OZARK.

W. T. Alexander, Udall: Barns are profitable in different ways. In the first place, we save not less than ten per cent. on our feed by keeping it dry. Secondly, we can keep stock on one-third less feed when well sheltered and kept warm. Third, we can save the manure to a better advantage than when it is dropped about on the ground where the substance will be washed out before being applied where needed.

S. A. Beach, Almartha: Sheltering stock and grain will pay largely.

PEMISCOT.

W. B. Tubbs, Portageville: Horses and cattle look forty per cent. better when sheltered, and are much healthier than when exposed.

PERRY.

C. U. Prost, Perryville: Barns are undoubtedly profitable, as they save much feed and are a source of comfort to both man and beast during the winter.

James Rice, Bois Brule: A good commodious barn is profitable, from the fact that a farmer can store his hay and corn, and all other kinds of feed in it where they will be preserved much better than if left out in the weather. They are also profitable in affording shelter for stock.

PETTIS.

V. T. Chilton, Smithton: The barns of this county are used principally for sheltering stock and for this purpose are very profitable.

W. F. Joplin, Ionica City: We could not do without barns on this high prairie.

PHELPS.

William Dawson, St. James: Barns are very profitable for sheltering hay, grain, sheep, cattle and horses.

O. P. Paulsell, Rolla: Barns are advantageous in protecting stock and feed, and saving manure.

E. K. Light, Newbury: Barns are very profitable in many ways. In importance, I think they are next to the dwelling. They are advantageous in protecting feed, grain and stock, and in saving manure from waste.

George Smith, Edgar Springs: I do not believe there is any person able to estimate the value of a good barn. By their use you save your feed in good condition, keep your stock warm, requiring less feed, etc., and last but not least, you save your fertilizer in good condition, and can apply it where you would most need it. This advantage is why I say no one can estimate the value of a good barn. I can not say which plan is best, letting stock run loose or keeping them tied in stalls; but I suppose there would be but little difference if they would quietly stay together.

PIKE.

W. F. Oglesby, Clarksville: Some of our stock dealers have experimented on the value of shelter for stock, and have concluded that with good, comfortable barns they get much better returns for their feed, and from one-fourth to one-third less feed is required to keep their stock.

PLATTE.

C. C. Graves, Weston: Barns are profitable, especially shed barns, in which we can feed stock without much expense.

POLK.

James M. Miller, Quincy: Barns are most certainly very profitable. I have a barn 22 by 40, shedded on both sides. I keep from 12 to 20 calves under shelter, and am satisfied that it pays well.

J. C. Smith, Fair Play: The old barns are fast disappearing, being replaced by new, more substantial and roomy structures, which are very profitable.

PULASKI.

A. J. Colley, Richland: A barn large enough to shelter all the stock and hold all the grain and forage of the farm is very desirable and indeed profitable:

D. B. Colley, De Bruin: Barns are profitable in every way they have been used, and I am sure they would pay well for sheltering cattle.

J. H. Ross, Big Piney: My experience has satisfied me that barns pay well. I have two on my farm which hold all my feed, farming implements, etc., and stock during stormy weather. One of my barns is floored, which I consider a great saving in feed. My barns are equal to one-half the produce raised on my farm of 125 acres.

U. B. Vaughn, Tribune: The profits of barns consist mainly in storing away hay and having a shelter for stock during the severe weather in the fall, winter and spring months.

PUTNAM.

J. W. Patterson, Xenia: We find it very profitable to store our hay and other provender under shelter; also, as a shelter for stock in the following ways: First, they save at least twenty per cent. of the

feed thus cared for; second, the shelter and comfort thus afforded stock will save at least ten per cent. of the feed otherwise required; third, the satisfaction in knowing that the poor dumb animals are thus made comfortable is worth something to the humane granger.

D. W. Pollock, St. John: Barns save a great amount of feed, and stock will winter with much less feed when kept in a barn than if exposed.

M. Young, Allerton: Barns are very profitable; first, for sheltering stock, especially young stock; second, in securing feed from waste, and I think twenty-five per cent. can be saved in protecting grain and in convenience alone; third, sheltering agricultural implements.

T. U. Wood, Terre Haute: I find barns profitable in taking care of stock in bad weather, but think stock do better when the weather is fair out on the farm, besides you can save the labor of hauling both manure and feed.

RALLS.

A. V. Beavers, Madisonville: By experience I find that stock do better on three fourths the feed when sheltered that is otherwise required. Again, in feeding in barns all the feed is utilized, which is equivalent to one fourth more. Hence, on the feed required for a given amount of stock when exposed, you can keep double the amount if sheltered. Besides, you can save all the grass seed needed, and the manure saved by barns is very profitable.

Judge I. T. Dawson, Hassard: My experience in sheltering stock has been very satisfactory, indeed. Several of my neighbors have had a more extended experience, and they do not hesitate to say that barns and open sheds will save fifteen per cent. in actual feed.

J. D. Meyers, Perry: I consider barns and sheds for stock profitable. Sometime since I built a cheap shed for my feeding-cattle, and am satisfied that the extra gain made by them paid for my shed each month I used it.

A. S. Smith, Hannibal: The most direct evidence I have is in wintering cattle. Their improved condition in the spring, as compared with that of those exposed during cold and inclement weather, was conclusive evidence that barns are profitable.

G. W. Waters, Centre: In considering the profits of the barn, we are all aware that they are valuable in protecting our crops from waste, both when being fed and from damage by the weather; that stock do much better on less feed when housed, etc., etc. But there is one very important feature which is usually overlooked, viz.: The care of the manure. We are not up to the standard of saving liquid manure as yet,

and the nearest we approach it is by bedding our stock, and frequently removing the refuse to fields and "marrying it to the soil." This is an important source of income, when properly manipulated, but when dumped out the window during the busy seasons and allowed to lie under the eaves of our barns until we are at leisure to apply it, is of comparatively little value. Then I would advocate cutting down the shade trees in our branches, so that stock will seek shelter where the manure can be utilized and not be carried into the Gulf of Mexico.

RANDOLPH.

J. D. Head, Huntsville: The farmers of this county are beginning to see the usefulness of barns for protecting stock and the better securing of harvested crops.

William Quagle, Moberly: There is a large profit derived from the use of barns in saving seed and protecting stock.

James W. Rucker, Higbee: Stock do better on less feed when sheltered than when exposed. I find by experience with about eighty head of cattle and fifty mules that those having shelter thrive better and eat less food than those that have no shelter.

REYNOLDS.

Thos. S. Barnes, Logan's Creek: I find that farmers having barns take better care of their stock and feed, and the consequence is, it does not require so much food, and the stock come out in better condition.

J. S. Freeman, Cynthia: Barns are very profitable for sheltering stock, saving feed and preserving manure.

RIPLEY.

H. C. Cooper, Varner: Barns are very profitable. I have one on my farm 40 by 40 which cost about two hundred dollars. It holds ten head of stock, part of which are tied, six hundred bushels of grain and about forty tons of hay.

Ira Green, Gamburg: I think a barn will pay for itself in five years. My barn is shedded and I use the main building for hay, etc., and the sheds for stock. I would not be without it for twice its cost.

ST. CHARLES.

L. T. Henry, O'Fallon: For storing grain, hay and farm machinery out of the weather, shelter for stock and saving of manure, barns are very profitable.

W. H. Matson, Augusta: First, in feeding stock in barns you gain in flesh, the amount that would otherwise be expended in keeping up the animal temperature. Second, a farmer with a barn has every convenience at hand, not only for feeding but also for storing machinery, etc., when not in use.

Wm. Pfarr, Weldon Springs: One of the best investments a farmer can make is in building a good barn. Barns and good sheds are of great benefit to all kinds of stock.

Jno. Sleiner, Portage De Sioux: One of the main features of good farming is the barn. They not only save much feed from waste but the quality is also preserved and is much better for stock. I would prefer a good barn to a good house, as when my grain, feed and bedding is safely housed, I feel that my year's work is done.

ST. CLAIR.

J. A. Vaughn, Lebeck: They save feed and are advantageous in many other ways.

S. C. Gassom, Farmington: Barns save twenty per cent. of feed and thirty per cent. is gained by sheltering feed, such as hay, etc.

H. Sleeth, De Lassus: Barns are very profitable in saving manure and seeds for pastures or meadows.

STE. GENEVIEVE.

N. Cook Sebastian, Avon: I consider barns profitable in saving hay, fodder and other feed from being weatherbeaten; also for sheltering stock. Stock when sheltered require less food, besides the manur that is saved by housing stock.

ST. LOUIS.

C. R. Black, Price: Grass when stored in barns or sheds is saved with less expense, not a straw is spoiled, which is not the case when preserved in stacks. Corn fodder, wheat, corn, oats, rye, and in fact almost all the produce of the farm can be stored in a barn. Horses and cattle can be provided for in the same building, so that there will be no necessity for the farmer to wade knee deep in mud and snow in winter to feed and attend to his stock.

James A. Eddie, Affton: Barns are profitable on account of the shelter they afford to stock and the amount of forage they protect from damage by the weather.

William Muir, Fox Creek: Protection to farm crops and stock is essential to farm profits.

SALINE.

R. F. Gaines, Marshall: Barns are profitable for storing grain and hay beyond the damaging influence of the weather. Many of our farmers have built large barns with considerable room for storing hay, while those who are not able to build barns are building good sheds, which take the place of the old straw shed.

T. C. Rainey, Marshall: The fact that money spent for shelter is worth three times its value spent in feed without shelter, is sufficient evidence that barns are profitable. In a grazing county like Saline, large and expensive barns do not pay. It is better to have a number of cheaper barns and sheds on different parts of the farm, so that stock of different classes can be kept and grazed in separate enclosures. Most of the winter our cattle run and graze in the fields, and it is economy for the feeder to walk from barn to barn to do his feeding instead of going all over the farm to drive in his stock to one big barn. It does not cost much to build substantial sheds and small barns, and it is the best laid out investment a farmer and stock-grower can make.

J. F. Wheeler, Herndon: Stock are more easily kept with than without barns.

SCHUYLER.

J. J. Daniels, Lancaster: Much feed can be saved by the use of barns, and milk cows will do much better.

SCOTLAND.

P. H. Lancaster, Crawford: I think that barns are profitable, as it requires much less feed for stock when kept in a good warm place than when exposed to the storms of winter.

Frank Phillips, Azen: Barns will pay for the expense of building in three years in saving of feed alone.

John W. Pulliam, Etna: Much feed is saved by the use of barns, and stock well sheltered require less feed than when exposed to the weather.

SCOTT.

George E. Clark, Morley: Barns are profitable in many ways. As we have considerable wet weather during the fall and winter, which causes hay when stacked in the field to mould, they are valuable in protecting it from this waste. Again, much feed is saved by feeding in a barn, and stock when sheltered will thrive on less feed than is required when exposed.

SHANNON.

John Heart, Pike: I have had considerable experience with wintering stock in barns as compared with the old method. I tried an experiment once by keeping five head of cattle tied in a barn and an equal number was allowed to run loose in the lot. Both lots were furnished with the same kind and amount of feed, and those that were tied in the barn came through in fine condition, while the second lot were very poor when spring came. Therefore, I conclude that only one-half the feed is required for stock when sheltered. Again, I know from experience that one shock of corn fodder kept in the dry is worth ten when allowed to stand out.

SHELBY.

Jesse E. Bishop, Madrid: I will give a few reasons why I consider barns profitable. One-third the hay when stacked out as it is generally put up rots, or is wasted, but when put into a barn none is lost. Hence, the hay wasted in the field on fifty acres in five years would, if saved, pay for a good barn. It also pays to put your oat-straw in the barn where it is kept bright and nice. Besides, stock will do better on one-half the feed if both the feed and stock are properly sheltered. Every one knows that it is a pleasure to have our stock all safe and snug during stormy and cold weather. Every man is duty bound to care well for his domestic animals, and a good, warm barn or shed is the only way to do this.

William McCully, Cherry Box: Stock when sheltered can be kept in better condition with one-third less feed.

Henry Von Thun, Shelbyville: Horses do better in a good barn, besides, there is much feed saved by the use of shelter.

STODDARD.

T. L. Wilson, Bloomfield: Barns are profitable in saving feed from waste, also in sheltering stock, as they do not require so much to keep them warm.

STONE.

J. S. Crumpley, Robertson's Mills. Our farmers are beginning to see the advantages of barns for protecting their stock and sheltering farm machinery.

H. A. Massey, Galena: Barns are very profitable for sheltering our hay, oats, etc., and for sheltering our stock.

SULLIVAN.

Summer Boynton, Greencastle: General principles of protection from cold and storms, and economizing the feed necessary to keep up the animal economy, protection to forage and comforts in feeding; also less waste and probably more than all else, the building up habits of thrift and carefulness, are a few of the reasons for considering barns a profitable investment.

John Hart, Milan: Barns are certainly profitable for housing stock as well as hay, our principal crop, one-third of which is virtually lost under the prevalent system of stacking on the ground, for on the ground it is stacked almost universally, comparatively few taking even the pains to place anything on which to stack, selecting the more elevated parts of the meadow for the stacking, which is very carelessly done in many instances, so that fully one-third is from the various causes lost.

John C. Schnelle, Pollock: Barns are very profitable.

Isaac Stanforth, Green City: Barns are profitable if properly used. The products of the farm should be gathered into barns or sheds to protect them from the bleaching rains. By this means there is a saving of at least ten per cent. in feed. There is also a saving of ten per cent. in having your stock sheltered from the weather, besides an increase of ten per cent. in growth and an increased amount of manure is saved.

TANEY.

B. S. Branson, Branson: Had it not been for the protection afforded by their barns, many of our farmers would have sustained severe loss in young stock last winter, as they were short of feed.

Creed Hopper, Mincey: I have been a close observer for thirty years and am thoroughly convinced that money could not be invested in a way to save or make a greater per cent. than in good barns. The men who undertake to keep cattle without barns lose sufficient number each year to pay for a barn large enough to shelter all their stock.

TEXAS.

Josiah Bradford, Licking: We are enabled to keep stock in better condition with less feed by the use of barns.

G. A. Leavitt, Houston: Barns are very profitable, in fact, there is no other profitable way to winter stock.

T. Smith, Plato: Farmers winter with at least one-third less feed when their stock are sheltered than when allowed to run loose.

VERNON.

R. A. Baughman, Nevada: Barns are very profitable both in saving hay and the protection they afford stock, and in this way saving one-third of the feed usually required.

WARREN.

L. B. Bell, Pendleton: There is no doubt that barns save much feed and that the farmer can put on more flesh with less feed when he houses his stock than when they are allowed to take the storms.

James Johnson, Pendleton: Barns save feed and keep stock in better condition.

WASHINGTON.

E. M. Gready, Blackwell: Barns are very profitable and no farmer should be be without one.

W. M. Mattock, Potosi: I can only give the profits derived from my barn. It cost me $340, is 40 by 60, in which I can easily store twenty tons of hay, which yields me a profit of fifty per cent. when compared with the old method of stacking in the field, feeding in the mud, etc. Another profit of fifty per cent. is derived from feeding my stock under shelter during the stormy weather. And young stock will come out thirty per cent. better in the spring on twenty per cent. less feed when housed than when compelled to rough it through. The above has been my experience for the last two years.

William Riehl, Potosi: I shelter all my stock, and my experience is that cattle winter better with one-third less feed if properly sheltered, and you also prevent any loss of stock.

H. C. Thompson, Hopewell: The advantage of storing grain and grasses under shelter, and the housing of stock of all kinds is sufficient evidence of the profits of barns.

WAYNE.

C. F. Bruihl, Lowndes: Stock when sheltered are much easier kept through the winter and less feed is required. There is also a great saving of manure which is largely wasted when stock are not sheltered.

R. M. Rubottom, Greenville: Barns are of vast importance in this county for sheltering stock and grain.

Peter Stilts, Bollinger Mill: Stock will winter on one-half the

food required for an equal number when exposed, and they will come out in better condition.

M. S. Warren, Patterson: Barns enable the farmer to save his feed in a much better condition, and there is no waste when feeding in a barn which adds to the whole amount saved, besides stock will thrive on less feed when sheltered than when otherwise cared for.

S. D. Whitener, Gravelton: It requires one-third less feed to keep a given number of cattle in the same condition when housed, they look better and will sell for more money on the market. Besides the manure saved is of great value.

WEBSTER.

J. B. Banning, Marshfield: The advantages of barns are so self evident that I need not specify.

P. L. Dodson, Elkland: I had no barn during the first two years I lived in this county and I found during those two years that my stock consumed one-fourth more feed and came out poorer than since I have owned a barn.

H. N. Moreland, Stafford: About twelve per cent. will be saved by putting your feed in the barn as soon as harvested. About the same amount will be saved by sheltering stock, to say nothing of the exposure experienced by having to feed in the storms of winter.

B. B. Peck, Rogersville: Barns pay at least thirty per cent. on the money invested. The protection of feed and difference between the condition of sheltered and exposed stock will convince any one that they are profitable. Besides you can feed with pleasure during cold stormy weather.

WORTH.

G. F. Brane, Denver: Stock will do on one-third less feed in a barn and will be more thrifty when spring comes.

H. B. Boyd, Irena: I have been using barns for the last ten years and my experience is that they save ten per cent. on the investment. My method is to keep all the stock in the basement, leaving the upper part for feed. The great advantage in this is the economy of roofing, which is the most expensive part of such structures. My barn is 40 by 40 and will hold 80 head of stock by tieing a portion of them.

Jos. Simpson, Grant City: We cannot make stock raising in this county profitable without shelter. Few cattle are tied.

Jno. Winemiller, Defiance: Without shelter more hay is lost by being spoiled and tramped in the mud than is used, but when sheltered this is saved. Stock also do much better when sheltered.

WRIGHT.

B. H. Cantrell, Astoria: I passed through the winter of 1884 without a barn and my stock suffered severely, yet I had plenty of feed for them. During the last winter, however, I housed my stock, and although I had but little feed, my stock did well and came out in good condition. I consider that I saved one-third the feed by shelter.

H. L. P. Pool, Mansfield: I consider barns profitable for the reason that they are a source of comfort to stock, save feed and a great place to save manure.

Geo. Taylor, Mountain Grove: Barns pay very well as it doesn't take half the feed for stock when sheltered in bad weather, besides they will look better.

BARNS AND BARN BUILDING.

A paper read before the Institute meeting held at Laddonia, Mo., Dec. 15, 1886, by J. L. Erwin, Esq., of Fulton, Mo.

Every community has its peculiar style of barn and is largely judged for its thrift by its barns. The Pennsylvania bank-barns with overshoot are regarded by those people as without a superior, and possibly in that climate and character of soil, may be all right, but I doubt very much their practicability in our tenacious soil, even when the location is favorable. In Pennsylvania with its steep hillsides, it is an easy matter to select a site, where the team may go in at the gable end and the load be thrown down into the mows below, thus economizing man-power. This idea, however, of getting the load as high up as possible has followed many west. I noticed at Sedalia a large dairy barn with expensive, and, I may add, dangerous bridges rising to the second floor so that teams could draw the load to that floor. An elevator could have been built at less expense and inconvenience, which would have carried the ensilage to the bins or pits. The horse-pitchfork will more rapidly, and with less expenditure of power, raise the hay and carry it to where it is wanted in the mow. These outdo the labor-saving contrivance of our Penneylvania brethren, and give us the advantage of being able to put the barn where it will be most convenient so far as the dwelling and farm are concerned. We have a barn too that may be approached from any quarter, and entered at any point that may suit our convenience. We then have a decided advantage so far as location is concerned.

BARN PLANS.

Almost every farmer fixes up his own plan for a barn, and calls in a carpenter to build it. It meets his own limited idea for convenience to a dot. Loft room, or room overhead for the storage of hay

and grain, and convenience in getting this hay and grain to the stock is little thought of. For a moderate sized barn 42 feet in width is the most convenient as well as the least expensive so far as carpenter work is concerned, 24 feet is about as wide as can be framed in a single bent to support the roof without purline plates. It costs just as much to frame a purline plate at 32 feet as at 42. The number of tenons and mortises are the same, the only difference is the cost of the material, while the storage capacity overhead will be enormously increased. Take a barn 42 feet wide, with 16 foot posts on the outside, allow 9 feet for story below for stock, and it will hold as much overhead as a barn 29 feet wide 16 foot posts will hold filled from the ground up. In other words, you can put a barn 29 feet wide in the loft of a 42 foot barn. I wish to call special attention so the use of long caps and two posts, so that the posts in the stable may be placed where least in the road. Posts are very inconvenient to get about if in the feed-ways. Another important matter in framing by using the long caps is that the joist-beams need not be spliced, but the ends simply squared and butted together. A couple of one and one-half inch pins given a slight draw will hold equal to a splice and is much more quickly and easily done.

The roof should have nearly or quite a square pitch. In a frame 42 feet wide there is very little waste in framing; if 16 foot posts on the outside are used, 16 feet will be the proper length for the purline posts; if 18 outside, 18 for purlines; and if 20 foot posts are used outside, 20 foot purline posts. In a steep roof much less tie timber need be used, as the pressure is downward instead of outward, and the snow will not accumulate upon it. By using the long caps suggested, the purline posts may be set 20 or 22 feet apart, equalizing the length of the rafter. Use a 2 by 6 pine rafter if it can be obtained, as there is so much less spring in it, and it is so much lighter to handle in putting up. In building a barn with a manure cellar the thought must be fixed on getting the pillars and posts so placed that they will not interfere with easy access with the team. This difficulty is met as here

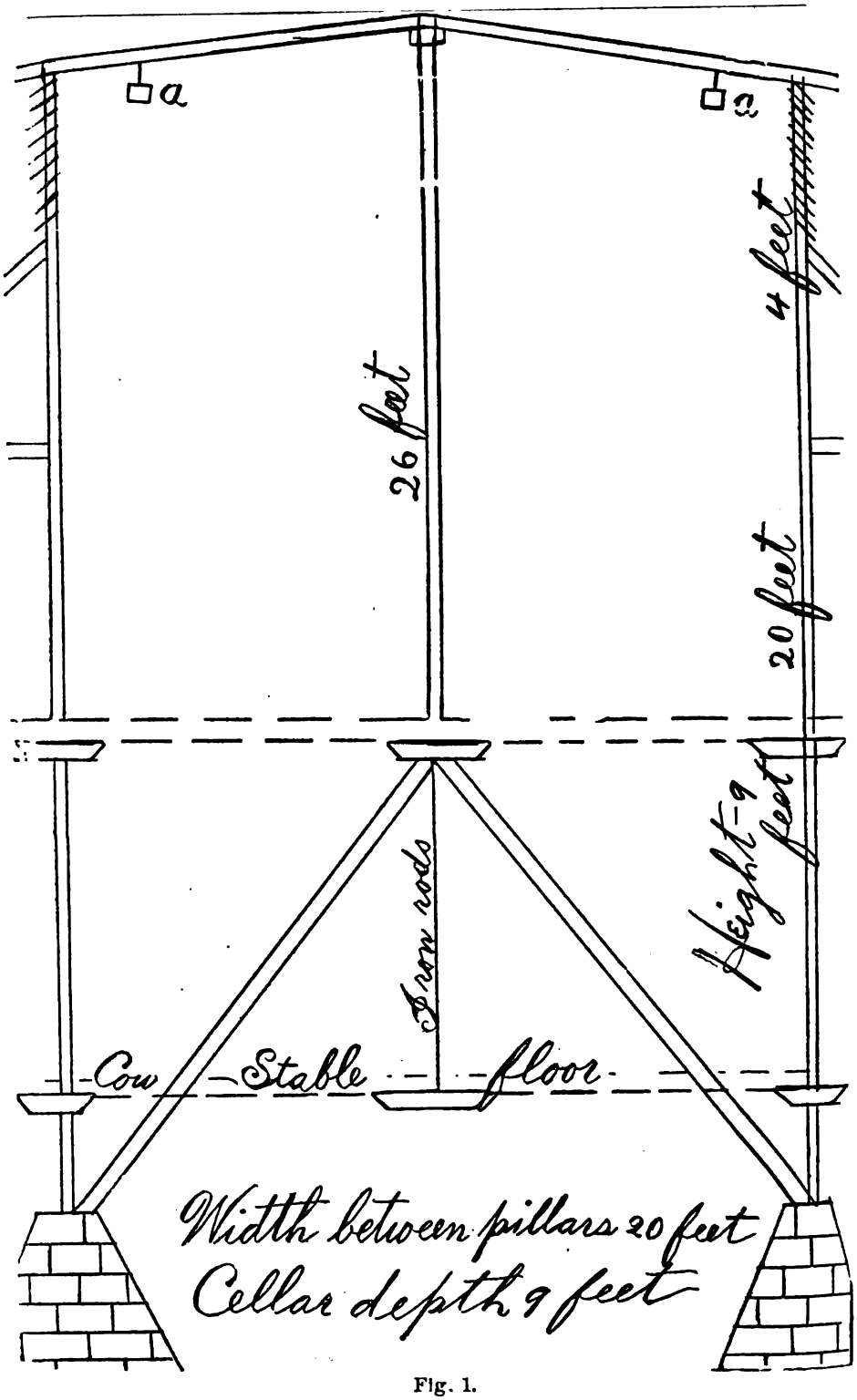

a
a
26 feet
4 feet
20 feet
Height-9 feet
Iron rods
Cow Stable floor
Width between pillars 20 feet
Cellar depth 9 feet

Fig. 1.

illustrated in Fig. 1 by diagonal braces or posts supporting the mow beams, and swinging the stable floor between. This has been the most difficult problem to solve in my barn building experience, and could I have had this plan suggested to me when I began, I could have made some cellars, I have built, much more convenient.

After 42 feet, I would not build less than 60 to 64 feet wide, or wide enough for four sets of cattle to feed, or two rows of cattle and two of horses or mules. I have built more particularly for cattle.

My plan on this style of barn is a deck roof, the upper portion

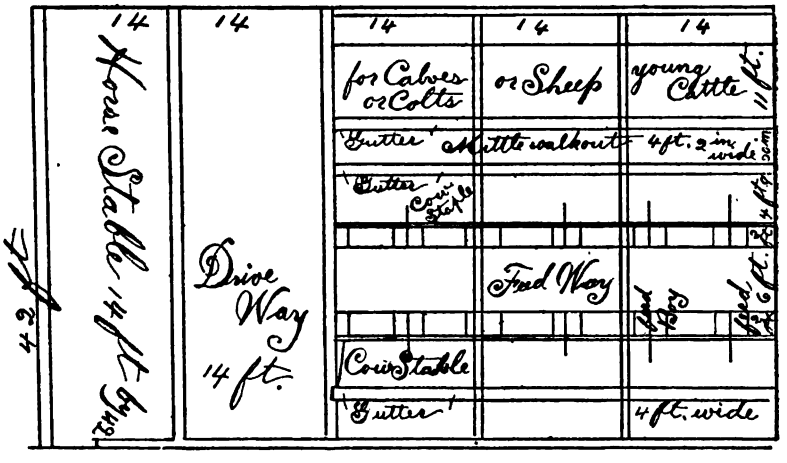


Fig. 2.

comparatively flat and made of iron or tin, the lower section of slate or shingle and steep. I support this roof by posts and plate in the center, thus getting rid of a very large amount of tie timber again, except at the drive-way and end. I have no ties at all in the center of building. If the roof is supported at the center the building will not spread.

I then put the hay carrier tracks about 4½ feet from the deck plate on each side. This allows nearly all the labor of mowing the hay to be done by horse-power.

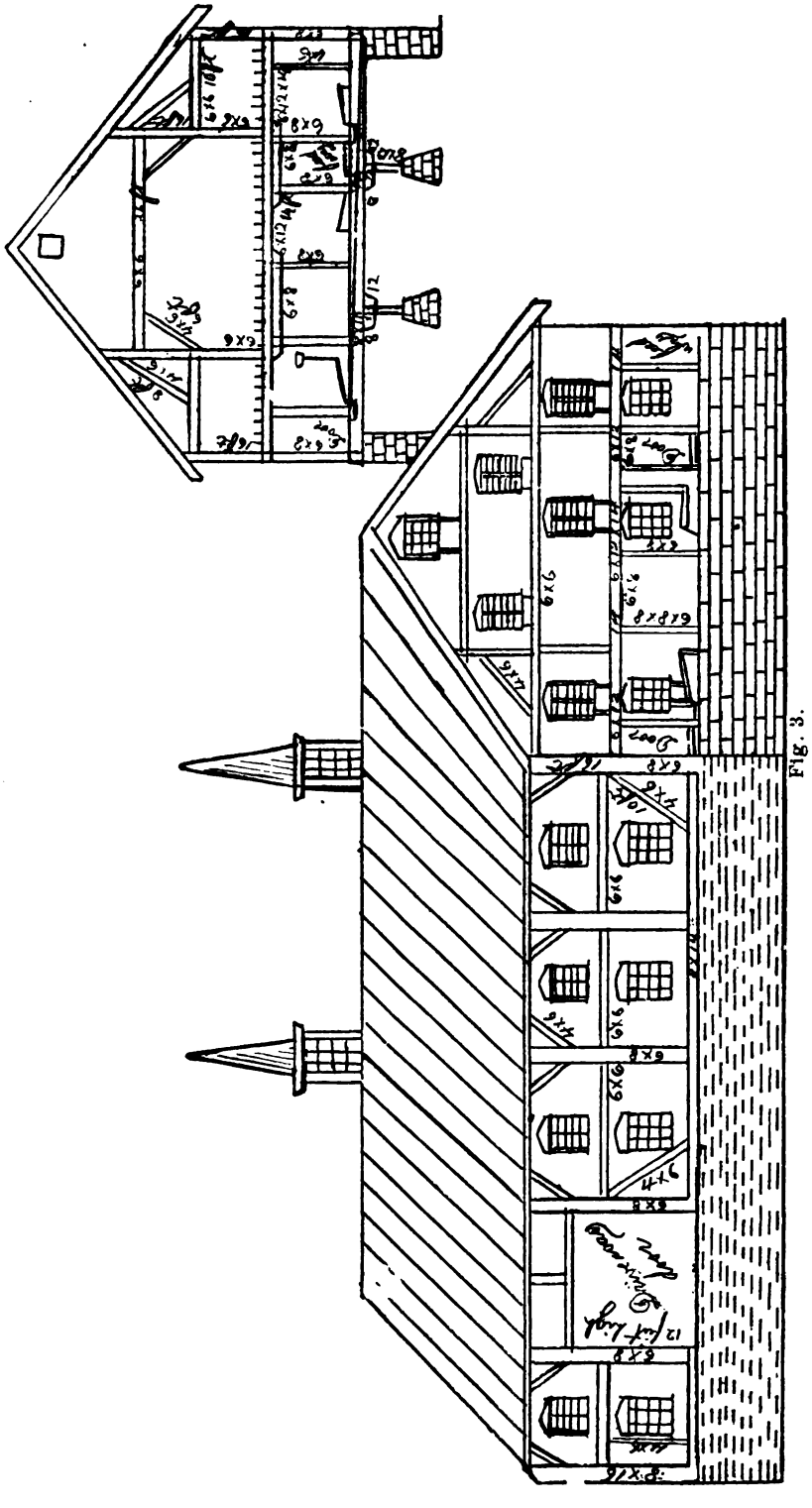


Fig. 3.

In a barn of this size I make the drive-way 16 feet wide, so that one wagon or team may easily pass by another standing on the floor. I economize the space over the drive-way with grain bins, which I easily reach with an elevator, and draw from by a down spout or chute.

NOTE.—Mr. Erwin does not allude to his steam power for elevating corn to bin, for grinding, for shelling corn, for running dairy house and for warming the water for his large herd of cows. Mr. Erwin has a convenient barn and manure cellar, which is the result of experience in building.—SECRETARY.

GAYFORD GLEN BARN.

BY GEO. C. BULLEN, ESQ.

Located at Gayford Glen farm, near Marshfield, Mo., and owned by Mrs. A. M. Gayord.

We concluded that we could not successfully handle stock without a barn sufficiently large to shelter the cattle and protect the feed. We built a foundation 32 feet by 76 feet, and extended it on three sides for a 22 foot shed, making a total of 54 feet by 120 feet. The main part is 24 feet high to the eaves and 36 feet to the ridge. The barn fronts south on ground sloping from east to west. The east end is 12 feet to eaves and the west end 18 feet, and the north from 12 to 18, with the south 24 feet. The loft above the main building extends clear over the sheds. The manger in the sheds runs through the center of the shed entirely around the building as shown in Fig. 1,

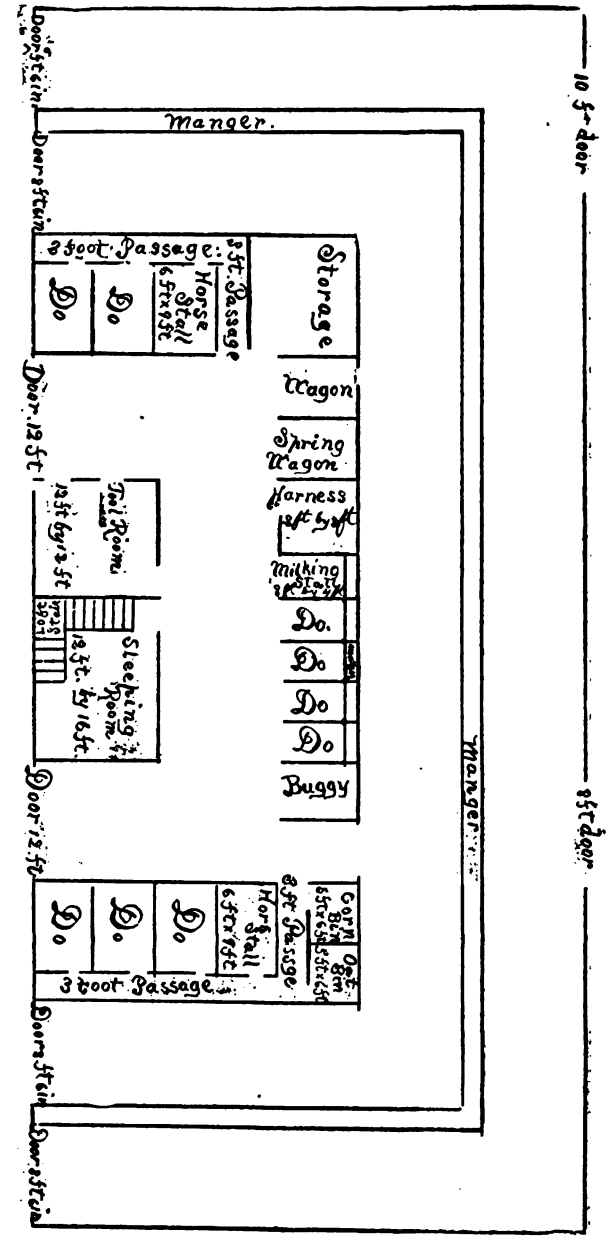

Manger.
Storage
Wagon
Spring Wagon
Harness
Milking
Do.
Do
Do
Do
Buggy
Tool Room
13 ft. by 12 ft.
Sleeping Room
13 ft. by 16 ft.
Horse Stall
6 ft. by 8 ft.
3 foot Passage
Do
Do
Do
Do
Do
Door 12 ft.
Door stein
Door stein
10 ft door
8 ft door
Manger.
Oat House
8 ft. wide
8 ft. high
20 ft. Long
Corn Crib
5 ft. wide at bottom
10 " high.
36 " Long.

Fig. 1.

so that the cattle feed from both sides of it. This gives 184 feet of manger, which being used from both sides gives a total of 368 feet. The manger is 2 feet wide at the base and 4 feet at the top and is fed from above through trap doors. It is made with a tight bottom and sides for 3 feet in height to save the food from waste and also to save the seed. The 10 feet on either side gives ample room to run a cart through to haul out the manure. On the ground floor of the barn proper, are the harness and tool rooms, work shop, a sleeping room for two men, places for wagon, buggy, hack and farm machinery, etc., milking stalls and stalls for horses, bins for feed. etc.

We load the hay into the loft through trap doors in the center of the building and outside doors at the ends, and on the long side a gable built out with an outside door.

The framing is of oak lumber, and the outside of white pine "ship lap." It required about 7,000 feet of lumber and 80,000 shingles. We have partitions so that the joists for the loft floor are but 8 and 12 feet in length and of 2 inch by 10 inch timbers spread 16 inches apart, which I think will be strong enough to carry the load when the loft is filled. I forgot to mention that we are going to fix in the barn a convenient place for *dehorning* cattle, for the time has come when "horns must go!"

MEETINGS OF THE BOARD FOR 1886-7.

The following review of the meetings held by the board in various sections of the State will cover, with few exceptions, only the discussions, while the addresses will occur in the body of the report.

These discussions are among the most valuable feature of the meetings and often include matters of greater value than the addresses given. It is unfortunate that the board has not the means for employing a stenograper. In another year it is hoped that it will be in a position to do so. The Secretary, who has almost always had the general charge of the meetings, has often had a part in the discussion, and hence has been unable, by the ordinary process of note-taking, to give but few of the questions and answers and general observations of the meeting.

It may be said that these meetings are greatly increasing in popularity. The audiences and their enthusiasm are enlarging year by year.

This work was begun four years ago with little or no funds, and at the utmost could hold for the first two years but from three to five meetings. This year it holds eighteen, and instead of asking for a hearing we now receive more invitations to hold meetings than funds will permit us to call.

MEETING OF THE BOARD AT MT. CARMEL.

The first meeting of the series was held at Mt. Carmel, Audrain county, September 21, 1886, in connection with the Fall Festival of the Grange of that place, and was well attended.

The secretary gave an address on the "Relation of Science to the Social, Intellectual and Material Position of the Farmer."

Prof. L. R. Taft, of the Agricultural College, delivered an address on "Fruit Growing."

MEETING OF THE BOARD AT KANSAS CITY.

The second meeting was held at Kansas City October 27 to 29, 1886.

While these meetings were held under the auspices of the Fat Stock Show, two members of the board were present and assisted at these meetings.

The following report of the meetings, with the exception of Mr. McCulley's paper, was taken from Colman's Rural World:

MEETING FOR THE DISCUSSION OF BREEDING, FEEDING AND CARE OF SWINE.

On Wednesday night of the week of the Kansas City Fat Stock Show, the breeders in attendance assembled in the St. James Hotel to discuss matters pertaining to breeding, feeding and care of hogs. Prof. J. W. Sanborn, Secretary of the Fat Stock Show, called the assembly to order and stated the object of this and the meetings for the two succeeding nights. He had thought it well, while so much of the experience and knowledge of the breeders and stock raisers of that section of the country was gathered here, to get the possessors of it together, and in informal discussions impart this to others. This meeting was to have been given to the discussion of the hog, but he was disappointed in not being able to present speakers specially prepared on the subject. He had had the promise of two men well qualified to address the meeting, to be present, but neither was here.

Mr. W. S. White, of Sabetha, Kas., was elected chairman, and on taking the chair he called upon those present to address the meeting on the topic for discussion.

A gentleman from Cherry Vale, Kas., stated that he selected the best young sows he could get for breeders. He wanted them about

one year old and to weigh 250 to 300 pounds, when they come in. He used a pure bred Poland China boar. He would feed all the corn the hogs will eat so long as they have plenty of grass. Did not think it would hurt them when eaten with grass. He did not keep hogs longer than one year unless it was breeders, and expected them to weigh 250 to 300 pounds when sold. He would have plenty of water for the hogs to wallow in, but had besides plenty of good pure water for them to drink. His sows were turned off after raising one litter of pigs. His success had been at least as great as that of any of his neighbors.

Mr. Cowan, of Holt county, member of the Missouri State Board of Agriculture, was called upon. He said he thought only those should be called upon who had made hogs a specialty. He had only handled hogs as followers after cattle and had paid but little attention to them. He would make a suggestion, however. Referring to a bulletin published by Prof. Sanborn giving the results of feeding for lean meat, he thought that a matter of interest to all present and they would like to hear the Professor on the subject.

Prof. Sanborn said that he had concluded that offering premiums for dressed carcasses was of but little value to this generation of breeders. In the battle of breeds as now waged, the breeders do not take into consideration the effect of food on the animal. It has been abundantly proven that the character of the food largely affects the character of the flesh of the animal.

The Professor then explained the difference in foods, how some, such as corn and rice, were highly carbonaceous or fat-formers, while others, like clover and linseed meal, were flesh formers or albuminous, and the effect of each of these classes when fed to the animal. By feeding shipstuff and dried blood, both albuminous foods, to pigs, while others were fed on corn, he had largely increased the per cent. of lean meat in the shipstuff and blood-fed pig over the one fed on corn.

Not only was there a difference in the muscular tissue of the animals thus differently fed, but even the vital organs were changed, showing that the food may have a decided effect on the health of the animal. The color of the fat of these two pigs was also different.

If these facts are true and so much difference is brought about in two pigs of the same breeding and as nearly alike as possible at the beginning of the experiment, and cared for similarly otherwise but in the feeding, what is the use of dressed carcass rings in shows such as we are having here unless the competing animals are fed according to the same system? It is with these facts in view that I had proposed to the different thoroughbred stock associations, particularly those of the different beef breeds of cattle, to place upon the College Farm at Colum-

bia, a set of steers, representatives of the different breeds, there to be fed and handled alike, and by this means determine the comparative merits of the breeds in a battle carried on under conditions equally favorable to all. They would thus be able to determine many important matters which cannot be settled by individual effort.

In reference to the question of early maturity that had been referred to, it had been fully determined and he thought it should be set at rest, that the older the animal is, the more it costs to put upon it a pound of growth.

He was satisfied that the hogs of Missouri were losing their owners money by not being put on the market as soon as they could be. If these hogs were fitted for market as soon as possible, he was sure the balance would be on the right side. He had been laughed at once for saying that one should make his hogs weigh 250 to 300 pounds in a season, yet here is a practical farmer who confirms my statement.

Q. Do you cook food for hogs?

A. No, it does not pay. A pound of food is not worth as much after cooking as before. This has been tested by many and the general result has been that the cooking is a positive injury.

Q. Will it pay to grind food for hogs?

A. I think it will, and the finer the better; not simply cracked. Even the cobs pay for grinding for pigs; 100 pounds of cob meal have given me as good results as 100 pounds of clear meal when fed to pigs. Will not pay to feed it to cows.

Q. Would you grind corn fine when feeding it alone to cattle.

A. Yes.

That is contrary to the experience of our best feeders.

As the discussion was drifting away from the topic of the evening, the chairman suggested that remarks be confined to the hog.

Prof. Sanborn then gave a few points on the general management of pigs. He would wean early, especially if the sow was expected to have two litters a year, and if not, by taking the pigs away early would give a chance to fit the sow for market. He had seen pigs weaned with good results at four to six weeks old; but they must be started carefully. Shipstuff he had found to be excellent food for young pigs, and old as well. He knew of no better food than this and skim milk combined. Pigs intended for market should be put up into a small but clean pen and there kept. Grass should be cut and taken to them. It would cost less to feed it thus than to let the pigs do their own cutting and gathering.

Mr. Cowan thought it would be difficult for a farmer, unless he was a specialist, to handle hogs in that manner.

Mr. B—— would not take pigs away from the sows so soon, and would be satisfied with plenty of corn and grass, letting the hogs get the grass for themselves.

The question of hogs following cattle was discussed at some length, but it was shown that there was need of hogs with cattle only when the latter were fed in such a way that they were not getting the full benefit of the corn.

HOG CHOLERA.

The subject of hog cholera coming up, a gentleman present, Mr. Weston, claimed that he had a positive and sure cure for any case of true hog cholera, but that he had tried in vain to get governors of States and other public officials to give it a test.

Chairman White asked him if he could tell what hog cholera was, and to give the symptoms of the disease, so that those present could tell if it was among their hogs. He could give no clear answer.

Dr. Ed. R. Allen, Live Stock Inspector at Kansas City Stock Yards, was called upon to give his views. He said this was one of the questions most interesting to stockmen. So far the disease has defied the best information and most searching investigation. Hog cholera cures have abounded wherever there has been cholera, but without effect. He had no doubt that the gentleman present was honest in thinking he had a sure cure, but he, the speaker, had no confidence in it. He thought the time not far distant when there will be a virus which can be used to prevent cholera, but it is questionable if it will be of practical use. He thought we would soon be able to put into effect quarantine and sanitary regulations, which would be effective.

MEETING OF CATTLE MEN.

On Thursday evening, Oct. 28, during the week of the Kansas City Fat Stock Show, a large company of men met in the parlors of the St. James Hotel, to listen to papers and addresses on, and discuss matters pertaining to the cattle interests. The parlors proved too large for the gathering and the meeting was adjourned to the large dining hall.

Secretary Sanborn had fully expected that Prof. E. M. Shelton, of the Kansas State Agricultural College , Col. Chas. F. Mills, Seretary of the Illinois State Board of Agriculture, and other well-known speakers to be present with papers. They had not come, and he had not been informed as to the reason for the disappointment.

Mr. B. O. Cowan, of Holt county, Mo., member of the State Board of Agriculture, read a paper on the Cattle Industry, which will be found in the body of this report. He speaks of the importance of the animal industry in this country. The demand for meats is a constant and a growing one, so there need be no fear of overdoing the business. But cattle breeders and raisers were not to have success without hard fighting. What most threatens our cattle interests? Pleuro pneumonia, that has worked such havoc and loss in other countries now threatens to seriously cripple this vast industry of ours. State and national law-makers have been importuned to pass effective laws for the suppression of this disease, but to little purpose. Congress has passed a law but not the law needed. Besides the apathy of many, we are opposed by a large class who pretend to be leaders of public opinion, and who do all they can to defeat any measures which are designed to protect and promote this great and necessary industry. Compare the financial and economic value of this industry with any other in the country—the cotton, wool, steel, iron, and various manufacturing industries, all of which seek and obtain protection, and then say, why should not this, on which so many depend for support and all for food, should not be protected by the government against diseases.

Prof. Sanborn followed Mr. Cowan in a few remarks in which he unfolded a plan by which he hoped to have the different thoroughbred cattle associations, select ten representative steers from each of the various beef breeds and place upon the College Farm, there to be fed to maturity under exactly the same conditions. By this means he hoped to be able to determine the true merits of the different breeds. It is only by putting the breeds on a similar basis can the "battle of the breeds" be decided. As it is now in contest for premiums and honors, animals are entered which have been raised under totally different treatment and feeding, and the superiority of one animal may be due more to this than to differences in the breed.

DR. PAQUIN'S ADDRESS.

Dr. P. Paquin, Missouri State Veterinary Inspector, read a lengthy article on the disease of domestic animals, which is embodied in this report. He argued that these diseases were propagated by the transmission of germs of the disease. That these germs existed, many did not now dispute, but the theory advanced by some that these were the results and not the cause of the disease was no longer tenable in the light of scientific investigation. The germs can be seen under the microscope, and manipulated in the laboratory, and disease produced by them at the will of the scientists. The innumerable number of floating particles is shown by allowing a ray of light to pass into a darkened room. The disease germs or bacteria are much more minute still. Among these myriads of specks to be seen in the sunlight, many were living though perhaps dormant organisms, some of which are messengers of death, while others are necessary for life. Some of these germs may be preserved an indefinite length of time under certain conditions, to be awakened into activity under others. These also may be easily conveyed long distances in the air and attached to other dead and living matter.

WHENCE COME THESE GERMS?

The origin of these germs is a question from which the student turns as from an unsolvable problem. But we need not discuss their ultimate origin; suffice it to say that in the light of the present knowledge, we must admit that they do not now exist, excepting as they have come from other living organisms (their ancestors). We often see contagious diseases breaking out in a locality, and cannot account for the outbreak, excepting on the theory of spontaneous generation, due to the favorable conditions, but we do not realize the innumer-

able ways in which these almost invisible organisms can be carried about. Of course the more favorable the conditions, the more certain the outbreak.

The doctor then discussed at some length pleuro-pneumonia, hog cholera and other diseases, treatment of them, and steps that should be taken by States and the country to suppress them.

Following this paper, Dr. Laws, President of the Missouri Agricultural College, made a few remarks. He read a paragraph from a printed lecture of his on the "Life and Labors of Louis Pasteur," showing the value of State aid to scientific labors, and then referred to what Missouri was trying to do through her Agricultural College, and State Board of Agriculture in this direction.

MEETING OF SHEEPMEN DURING THE KANSAS CITY FAT STOCK SHOW.

The breeders and farmers in attendance at the Kansas City Fat Stock Show, who were interested in the breeding and management of sheep, met on Friday evening, October 29th, in the parlors of the St. James Hotel, to discuss matters pertaining to this industry. The room was well filled when Prof. Sanborn called the meeting to order. Mr. McHardy of Lawrence, Kansas, was elected chairman. Mr. R. T. McCully, of Lee's Summit, Mo., read an essay, delivered by him before the Missouri Wool Grower's last meeting, on the Care of the Merino.

He said:

"It is with a degree of embarrassment that I appear before you to speak upon a subject on which, no doubt many of you are better posted than myself. It is a question of vast importance, and one that we should be better posted on. There is a peculiarity about wool that not one shepherd in twenty knows anything about. To have a uniform growth and of equal strength, the wool must grow steadily, as the season advances. If sheep are allowed to fall suddenly away the growth of wool ceases. When growth again commences, the wool, instead of continuing even in texture will have what is termed a joint. This is not profitable wool either for the producer or manufacturer, and is caused by improper feeding and non-attendance or lack of judgment in the shepherd. The microscope will reveal every period of starvation and subsequent good feeding that sheep may have experienced in the course of a year's growth of wool.

"Gentlemen, the question is, how shall we avoid this weak and unprofitable growth of wool? I would answer, by regular feeding. Regularity in feeding is one of the secrets. Therefore, the shepherd who would do well for himself must do well for his flock. He must not only feed and water well and attend to the general health of his flock, but house well. All feeders who have studied the habits of the animals they feed have observed that they take special note of the time, and are disappointed if the time is delayed only a few minutes. It is

a point to observe great regularity in the time and quantity for feeding sheep. It has been observed that a careful and regular feeder will produce a better result with inferior food given at regular times and even quantities, than an irregular feeder as to time and quantity with the best of food. And it may be truly said that the shepherd's eye, which takes note of the individual wants of his flock, is worth a great amount of carelessly given food. For the best mode of producing wool, I will give, first, what I consider the best mode of spring feeding.

"First—The flock should be graded as to age and sex and kept separate. Every flockmaster should have a nursery for the weak ones, where they may receive special attention and care. The flock should go into pasture as early in the spring as possible, but should be housed at night and fed hay grain. They should be kept out of all cold storms in early spring. While this is true in its application to all members of the flock, it is especially so to those animals upon which depends the handsome item of increase. In the treatment of breeding ewes, there is no other alternative but continuous feeding until both ewe and lamb can get full grass rations, or there will be disappointment when the flock is numbered in the fall. An unthrifty ewe can do no more than rear an unthrifty lamb, and succeeding this way, both become a target for disase. In the sheep business, as everywhere, man is the architect of his own fortune, and those who feed well up to the limits of prudence, are the men who are becoming the sheep kings of the day. Sheep should be salted regularly twice a week and have access to water every day.

AUTUMN FEEDING.

In autumn, as the season advances, sheep should have grain once a day. I prefer to feed grain in the evenings. If sheep are allowed to fail in flesh late in the fall, a mischief is done that cannot be remedied. I think that is where a great many shepherds lose in not feeding early in the fall. One thing is certain, lambs must be grained liberally, or else they must have a choice reserve of grass to wind up the grazing season on. If they don't they will lose flesh and go into winter quarters on the down grade. I feed my lambs more grain in November than I do in January. In January they are well established in their winter habits, and have an abundance of sweet clover hay, whereas in November they are in a transitory condition, gathering up under protest the leavings of the summer grasses, which the frost has weakened. I prefer, for lambs, as a grain feed, one part oats, one bran and one corn, at the rate of one bushel per day to 100 head; that is, after they get on full feed and all the clover hay they will eat, cut when in bloom and cured without rain.

WINTER FEEDING.

Secure good barns and sheds. Then divide your sheep in flocks of fifty to 100, if convenient, always keeping lambs to themselves. Provide good racks and troughs for hay and grain. I manage to feed what they will eat up clean and no more. I would rather stint them a little than give them too much. I always like to see them take hold of their feed with a relish. I feed hay or fodder in the morning, and turn out to water at noon if not too stormy. Fill racks with hay at 3 p. m., bring sheep in, and feed grain at the rate of one bushel to 100 sheep, of oats, corn and bran. When sheep comes in from a fresh run on pasture they are bright and keen, and lick up their grain quickly and do not mince over it, and move it along the trough in heaps for the stronger ones to monopolize. Here I would say that I like the flat bottom troughs better than the V shaped ones, because it prevents them from rooting the feed along and rooting it out. I prefer clover hay for lambs and half clover and timothy for older sheep, as it is more easily cured. Sheep upon farms suited to them are very profitable, but, however suitable the farm, the profit will be in direct proportion to the intelligent care and attention the animals receive. A well filled barn and the employment of common sense in distributing its contents will bring satisfactory results."

Mr. G. Y. Johnson, of Lawrence, Kansas, asked Mr. McCulley to describe what he would consider a good sheep farm.

Mr. McCulley said: "Rolling land is best for sheep. They will not do well on low, soggy land. You will find that sheep will seek the highest knolls on which to graze and lie.

Mr. M. thought the merino sheep more profitable, on the whole, than the long wools. One bushel of corn per day to one hundred head of Merinos was enough, but it would take much more for other and and larger breeds.

Mr. U. P. Bennett, of Lee's Summit, Mo., breeder of Cotswolds, said he made his flock yield 13 pounds of wool with shelter, and only 11 when unsheltered, and fed one bushel of corn and one of oats per day to 48 head. He thought there was more money in them than in Merinos.

Prof. Sanborn explained how a young and small animal will eat more food in proportion to weight than older and larger ones. Sheep will eat more according to weight than will cattle. He had found that this was borne out in feeding tests with the large and small breeds of sheep. Merinos would eat proportionately more than Cotswolds. He

commented on the statement of Mr. Bennett that 13 pounds of wool was got when the sheep were sheltered and but 11 when unhoused. Wool is composed of materials in the food, and this food also furnishes animal heat, and unless the animal is protected, some of the food which would have been converted into wool and flesh will be used to keep up the temperature.

Referring to lack of interest in the West in the sheep industry, he said sheep were the most profitable of all our domestic animals, but they were delicate and timid, more dependent on man's care and skill than other stock. Only the most intelligent and skillful farmers could handle sheep successfully.

He thought Missouri well adapted for sheep raising, with its rolling lands and limestone soils.

CROSS BREEDING.

Crossing one breed with another was discussed at some length, some thinking that a Merino ewe and a ram of one of the mutton breeds made a good cross, while others would cross the other way. Mr. McCulley said the Merino ewes did not make as good mothers as ewes of the larger breeds. He said that any one could make the first cross, but he had not been able to continue the good results obtained and knew of no one who had. He thought, therefore, there would always be need of breeders of thoroughbred stock to meet the demand for crossing.

Prof. Sanborn related how Mr. Bowditch, of Massachusetts, made a very successful cross between two kinds of corn and largely increased his yield; and thinking he could continue the process with good results, he tried it on a larger scale with the progeny of the crossed corn, but the result was disappointing. And this seems to be the result in both animal and vegetable kingdoms; first crosses give good results, but cannot be continued.

Mr. Hunt, of Kansas City, told what was being done by many farmers in the East, in the way of raising early lambs for market. One man he knew got $10 a head for his lambs and was getting rich at the business.

Mr. McCulley said there was money in that business if one was located near a good market, and in that case he admitted that the mutton breeds were the best and should be kept in small flocks. For large flocks nothing was equal to the Merino.

The question of dogs and wolves killing sheep was a troublesome one with many who desired to keep sheep, and they wanted to know

how to protect their flocks. It was stated that a small flock would run with a drove of cattle and be protected by them; others advised a barbed wire fence, and they should be yarded at night. Large flocks would pay for herding. Paying a bounty for wolves' scalps did not seem to do much good.

MEETING OF THE BOARD AT LADDONIA.

A Farmers' Institute meeting was held at Laddonia, Audrain county, on December 15, 1886.

Meeting called to order by Mr. Potts, President of the Board, who opened the meeting by briefly stating the purposes of the board. He believed that much good resulted from the meetings, and as the discussions were usually in a plain style, they could be appreciated.

AFTERNOON SESSION.

Dr. Paul Paquin, State veterinarian, addressed the meeting on intestinal troubles in horses and cattle.

Acute indigestion in the horse.—A great number of horses have died this fall from a disease supposed by some to be poisoning by worms or the product of the worm in the fodder and ears of corn. Whether these worms and their product and the smut in the ears have directly anything to do with the disease is a matter that is not yet sufficiently clear. There may be some principles in these products or waste matter of those germs which are ferments, but the worm in the stalk itself is harmless. Although it would be important to know just where the injurious principle is, there is one point which must be taken into consideration in order to prevent the disease and treat it when affected. It is the fact that in every case you find the symptoms of indigestion—that is, colic and intestinal bloating—which results in inflammation of the stomach and bowels, and frequently rupture of the stomach. These symptoms are always present. Therefore, no matter what the direct or immediate cause may be, you are compelled to deal with indigestion. Now, to understand how and why you have indigestion of a serious nature in the horse, let me give you a few words on the anatomy and physiology of the digestive apparatus.

The apparatus consists of the teeth, the œsophagus (or gullet), the stomach and smaller intestines. The digestive canal is about 92 feet in length from the mouth to the rectum, inclusive. Out of this enormous length of tube the capacity of the stomach does not exceed, as a rule, fourteen quarts. Digestion goes on, to a certain degree, from the moment the food enters the mouth where it is cut and masticated, chewed and thoroughly impregnated with saliva and made into a slippery mass to be swallowed. We see clearly the importance of good teeth and food that can be easily masticated, for horses especially, which have only a limited time to feed at each meal. A horse on dry fodder needs, as a rule, an average of 80 pounds of saliva per day to soften his food and act upon a portion of the starch formed in the food, converting it into sugar. In the stomach the albuminous matter of the food is digested, being converted into matter fit to be absorbed by the blood vessels and lymphatics into circulation to feed the body. This is done by a churning movement and mixing with the secretions of the stomach. The rest of the material, the starch not affected by the saliva in the mouth, is acted upon in the first part of the bowels (the duodenum), next to the stomach.

The nature of the food taken by horses differs greatly according to localities. Some give good, mature, shucked corn, others mature, unshucked corn; others again immature corn, while still others fibrous, indigestible corn, and corn fodder which has been allowed to dry on the stalk in the field and is useless as food. The indigestible and fibrous portion of the fodder overloads the alimentary canal, irritates it and the undigestible fermentible food, and causes fermentation in the stomach, the immature corn fed aiding in the work—and the stomach becoming strained to its utmost capacity, can stand it no longer, and may rupture. This trouble, however, does not always stop here but proceeds to the intestines. The gas generated during fermentation will not be restrained by these organs of digestion, but bloating takes place, congestion sets in, and death is the result. A horse must have sound or well matured corn, and shucked corn is less liable to ferment than immature corn in the husk. I also observe that I very seldom find a horse affected by this inflammation that consumes sound oats and sound hay. Regularity in feeding and in the quantity, and good quality of food will prevent many a dangerous case.

When a horse is suffering with this disease, it is useless to ride or run him, or to feed him on sour milk or vinegar, or do anything else to increase irritation, if not even fermentation, which will hasten death. Remember the capacity of the stomach—13 or 14 quarts—and capable of distending perhaps to 20 quarts, or a little more.

To give medicines then that will ferment and increase the amount

of gas, or which serve merely to fill the stomach, is simply increasing the trouble. Muriate of ammonia every hour or so is a good and safe preventive at the beginning of the disease—one ounce in a pint of water, making a dose. This tends to check the fermentation, but will not cure in all cases. To relieve pain, ½ drachm of fluid extract of belladonna, and one drachm of colocynth may be added. Injections in the rectum will assist the gas to escape in many cases. A mild physic should be used, care being taken in this matter, as a strong one would increase the pressure of the gases. One ounce of turpentine and linseed oil 1 quart, is good. Slight exercise by walking slowly is good when bloating occurs, otherwise keep the patient quiet.

The speaker then described the method of puncture given in a previous volume of these reports.

Indigestion Among Cattle.—The speaker first described the digestive organs of cattle, much as given in the report for last year.

It is in the first stomach that acute digestion proper takes place. The fermentive process goes on very rapidly in this stomach, and soft or fermetible food in excess readily causes great trouble. If from hard, dry food cattle are changed to green or soft food, it will be taken in excess perhaps and soon ferment and cause enormous bloating. This is relieved by puncturing the stomach, and by the use of muriate of ammonia as for the horse. Feeding on frosty foods in the fall, change from soft to dry foods are prolific causes of what is called dry murrain, indigestion of third stomach. This is treated by diluted acids, like 1 drachm of nitric acid in a pint or more of water twice daily and also a daily dose of raw linseed oil.

Q. Do bots kill horses?

A. No; the stomach is the natural abode of the bot. If in great number, they may perhaps affect the secretion of gastric juice, and so aid in troubling digestion, but they are not the cause.

Q. Do you ever give medicine with a syringe through the mouth?

A. Yes; it is an excellent way, especially for unruly horses. Use a long stem rubber syringe.

Q. Will lard or opium prevent fermentation?

A. No; this is not their function.

Mr. ——. I always use the syringe in giving medicine, and have used nitre for colic with success.

Dr. Paquin. The nitre acts on pain, and as a condenser of gases it seems, and is good.

A long discussion followed on the subject of bots being the cause of death in horses, it having been asserted that they have been found on the outside of the stomach after death. Dr. Paquin insisted that this occurrence was due either to rupture of the stomach during

indigestion, or to the action of the acids of the stomach which have the property of digesting dead flesh and consequently act on the stomach itself after it is dead, and thus it presents the appearance of having been eaten through after death.

J. L. Erwin, Esq., of Fulton, was the next speaker introduced. He said he wished to say a few words about digestion. I was called to visit some cattle last winter that were dying with dry murrain. I found the cattle eating over ripe hay salted, and drinking from a pond where the temperature of the water was a little above 32 degrees. Such conditions are enough to give the deaths from indigestion.

The speaker then introduced the subject of drainage. He said his men dug ten rods, two feet and a half deep, per day. I never buy T or Y joints, but fit them myself. I do this by striking the tile on the end, as it will fly to pieces if struck on the side. My method is to have the tile fit closely at the top and leave it open at the bottom for the water to pass in. If too open, I do not use them, as crawfish get in and dirt is soon deposited. I prefer two-inch tile to four, as the four-inch tile will warp much easier and leave the openings between the pipes too large. I drained the land around my house, placing the drains forty feet apart and two and one-half feet deep. The family before me had been troubled with the sore throat a greater portion of time, and chicken cholera was common. The same was true of my family until the land was drained, when all disappeared.

Q. What does it cost?

A. I dig ten rods per day and lay forty rods.

Q. I find the farmers fear that our clay will not allow water to go through it. Is our clay subsoil sufficiently porous to receive the water as in other countries?

A. Our soil is not impervious to water until packed or slicked over. The soil in its natural condition has cracks through it, and is crumbly, and I am sure that water will reach the tile.

Q. How about our ponds?

A. They are puddled, either intentionally or by the shaking force of the water.

Q. Will our flat prairie soils drain?

A. By Mr. Erwin, yes; and by Mr. Sanborn, yes. Mr. Sanborn stated that as a matter of fact, rains do enter the soil, otherwise our land would be worthless. It goes into the soil and furnishes our springs and underground veins of water. Drainage has already proved successful in Missouri. In England far worse land than ours is drained successfully.

Q. Does water enter the pipe at the joints or through the tile.

A. It enters at the joints.

Mr. ——. We think it would be better to drain by means of open ditches.

Mr. ——. I have no infidelity in drainage, but we question the water entering the tile.

Mr. Erwin. I have laid seven miles of tile with borrowed money. I drained until July this year and planted with tile.

Q. How would you drain a forty-acre lot on level ground.

A. By parallel drains forty feet apart, entering a main drain at the foot of an incline.

Mr. Erwin then introduced the subject of barns and said: "I am going to deliver this talk believing that you are all in favor of barns. The only question is that of means or cost of the barn that you propose to build. I am so radical that I am unable to see how a man can be a good Christian and allow his stock to drift about unsheltered during stormy weather, or go into church while his horse stands out shivering without a blanket. In a state of nature the horse can move about for comfort or seek protection."

Dr. Paquin, by request of the audience, gave a brief account of his trip to Europe to study Mr. Pasteur's methods of contagious diseases. The main facts given in this talk are to be found in Bulletin No. 24 of this report.

The following is a summary of his remarks:

To understand the principles of the vaccination and inocculations practiced in Europe by Pasteur's methods, it is necessary to understand well the "germ theory of disease." The contagious diseases of man and beast which are explained to-day are mostly all found to be due to a living parasitic organism of the borderland of the vegetable and the animal kingdom. Some are surely of vegetable nature. Those organisms cause disease by their growth in the body, in the organs where they find proper soil, just as wheat will grow in certain lands proper to its nourishment; and like plants too, some animals and some special organs of their body are more suitable for certain germs than for others.

That germs are tenacious of life, can stay years in state or spores outside the body and then grow in the system and cause disease again was well demonstrated by Pasteur's who, after having buried in an enclosed, isolated field the carcass of an animal having died from charbon found that some years afterwards, the beast, purposely placed in the field to graze, took charbon and died; and Pasteur discovered, we are told, by means of experiments consisting as usual in cultivation of the germs and inoculation, and the microscope, that the earth-worms carried the spores of charbon-germs from the carcass to the surface of the

ground where the grazing animal had access to them, and swallowed them with the grass. These results have actually been obtained.

The vaccination against that disease is very successful. It is done with germs, weakened by subjecting them to the action of heat, etc., and when so weakened they cause a fever, but not a sufficient disease to kill, but yet sufficient to render the subject proof against a subsequent attack for a long period.

The French swine plague is prevented by virus weakened by its passage through the rabbit which offers a poor soil for its prolification, just as horse-pox is attenuated or weakened to a certain extent by its passage through cattle.

The inoculation of Pasteur against hydrophobia is, it seems to me, no less a scientific and successful treatment than the former. So far as I can judge it rests on the same solid basis of the germ theory which will, I predict, completely revolutionize many opinions held to a recent date upon the subject of contagious diseases, and perhaps many others held as non-contagious. The criticisms treating Pasteur as a humbug are shameful. There are no principles of honesty about them. Mr. Pasteur is such a thorough conscientious Christian that I consider as insults, the condemnation of men who do not know him, and know little of his theories. He is the last man who would dare endanger his fellow-man's life for any purpose. It would take but a base murderer to risk the inoculation with hydrophobia virus, if it were as some claim still, a poison, and not made a preventive treatment as his genius has really and truly made it.

I have seen the noble scientist and seen him in his labors. I know whereof I speak. Some claim that his success, if any there be, is due to the moral influence, and that most cases of hydrophobia, so called, are nervous troubles brought on by such influences. Can these servants explain the moral influence that causes rabies in dogs, rabbits, etc., and the moral influence that saves them after Pasteur's vaccination? While there are many obscure points in this question of rabies, and its prevention, it is unjust to say the least, to so condemn Pasteur whose anterior labors have so benefited humanity at large.

Judge Raftry was asked to address the assembly. He said that he was glad to see farmers out to discuss farm questions. Our county has proposed to devote money to premiums for the encouragement of stock and agriculture. I am in favor of giving a premium to the firm manufacturing the best farm implements in the county. A petition will be presented to the court asking for money for such purposes.

Col. Clay was next introduced, who stated that he desired to say that this institute was about the only aid given by our State. Dr.

Paquin has given a valuable talk, Prof. Sanborn has struck a key note in his advice for better farming. In subsoiling one of our farmers has said that we have a new source of fertility. Our surface has been skimmed, but we have a strata of rich soil beneath us and we want to get at it, yet there is not a subsoil plow in the county that I know of.

This institution or our College of Agriculture is about entering upon a test of very great interest to us. I consider this trial of breeds the most important trial of the country. There will be something decisive in it. Mr. Erwin has given us an important talk on drainage. We have a neighbor who is draining, and if his trial results in a mellower soil or larger crops we shall learn from him.

Q. Does Mr. Erwin find drainage necessary when subsoiling is practiced?

Mr. Erwin.—On land that will bear deep plowing and let the roots in the soil, I advise subsoiling. I wish to keep the surface roots as near the top as possible and if one inch will suffice to destroy the grass, that would suit me.

Mr. Clark.—I cannot agree with the gentleman in his remarks, and find that our prairies are mellower when so cultivated.

Mr. Sanborn stated that tillage allowed the air to circulate through the soil, which favored disentegration, and deep tillage aided this.

Mr. Erwin.—I was misunderstood, and am in favor of deep tillage, but not the inversion of soil to such depths.

Mr. ———.—I have worn out much horse flesh plowing deep, and now want only two inches.

After the audience had tendered the board a vote of thanks the meeting was adjourned.

MEETING OF THE BOARD AT ROLLA.

A Farmer's Institute meeting was held at Rolla, Phelps county, on December 21, 1886.

Dr. Frost, of that place, was chosen chairman.

THE MORNING SESSION

was opened by Secretary Sanborn, who spoke in detail of the work of the Board and the purpose of its organization. He then spoke at some length of the growth of agricultural science, its relation to modern agriculture, and to the life and character of the farmer. Agricultural science is destined to revolutionize everything that pertained to or characterized all preceding agriculture.

At the conclusion of Mr. Sanborn's remarks a paper on "Fish Culture in Relation to Agriculture in Missouri," was read by Judge J. W. Emerson, member of the board from Iron county, which will be found on pages 203 to 210 of this report.

At the conclusion of the reading an adjournment was taken until 2 p. m.

AFTERNOON SESSION.

Met according to adjournment with Dr. Frost in the chair.

The first address was by Professor L. R. Taft of the State Agricultural College on the subject of Fruit Growing.

He advocated the use of young trees obtained from a reliable nurseryman, and was not so much opposed to grass in an orchard as many professional nurserymen, provided a vigorous growth of the trees was secured. The plan of allowing sheep free access to bearing orchards

was advocated. They will eat the smallest fallen fruit containing the larva of the coddling moth and curculio, while the hog will not do this. If the orchard is well set in grass and not grazed too closely, the sheep will not trouble the trees. The trees should never be severely pruned as the leaves are their lungs, and trees are injured by cutting off large limbs. Only small twigs, sprouts or buds should be taken off, and if the tree is properly cared for the saw will be seldom needed.

SMALL FRUITS.

Strawberries.—The Cumberland Triumph and Captain Jack are the two best varieties, and can be gotten conveniently and cheap. They should be planted in rows three feet apart and one and a half feet apart in the row. During the first winter they should be mulched to protect them from injury by freezing and thawing. This mulch will also serve a good purpose in the summer if left between the rows, by preventing the weeds from coming up, guard against drouth, and keep the fruit clean. In picking the fruit I make two grades and find it desirable.

Raspberries.—They are easily propagated and hold for six or seven years. They may be grown in rows or planted in hills. When grown in hills, however, they should be planted further apart than when in rows. They should be kept free from weeds. The Turner is now a great favorite all over West. The Cuthbert is often used and while it is not successful in Columbia it does well near by. The Thwack is quite popular.

Blackberries.—This fruit is often grown successfully in the State but is not profitable when it has the wild variety to compete with.

Q. What is the lowest price we can sell at?

A. Eight cents per quart.

Q. What is a fair yield?

A. It varies, but about thirty bushels per acre would be a fair yield.

Q. What is a fair net profit on a crop?

A. When you can sell at eight cents per quart your sales are safe, and at more it is profit. It costs but little more to raise a crop than a crop of corn.

Mr. ———, I have grown strawberries and find them no more trouble than common crops.

Mr. Chubbuck of the *Rural World* was called for and responded by advocating good roads.

He said: I believe that few things can be done more beneficial to

our farmers than the improvement of our roads. We voted on an amendment of the laws regarding roads some time since and I am sorry to say it was defeated. Our present system of working the roads involves inefficient labor and should be changed placing the management under one responsible head. It has cost a county as much as $700,000 to get twenty-five miles of railroad, over which two hours is required to make a trip. If this money had been judiciously spent in constructing rock roads it would have been much better for the citizens of that county.

Our impassable roads in the muddy times are an obstruction to the movement of farm produce. Three or four times as heavy loads can be drawn over our rock roads as can be drawn through the mud on the average dirt road. These good roads aid in social life and admit the use of light carriages.

Mr. Rushmore of New York was invited to address the audience.

He replied by saying that he had no address to deliver, but would answer questions coming within his experience in farming. He remarked that his experience taught him that he had had enough ensilage.

Q. Which is the best breed of poultry?

A. None of them; crossing has given poor results in each. He related his experience with a lot of Light Brahmas that laid three hundred and twenty-five eggs before they offered to set. So I don't say *breed*, but *strains*. I have had Leghorns that were good setters. The larger breeds will be more desirable when eggs are sold by weight. I can tell what will cure the gapes, if you desire. I applied to an eminent New York chemist, who advised pyrethrum powders. The disease is caused by an insect which stands on its head. I dust the powder over the hens, which always cures. Put the powder on the hen before the chickens hatch.

Q. Where can we get good pyrethrum?

A. From any good, reliable wholesale house. It will cost about thirty or thirty-five cents per pound when obtained in this way.

For farmers a cross is the best; such as a cross between the Leghorns and Brahmas; yet a cross between Light and Dark Brahmas is always bad.

Q. What will cure chicken cholera?

A. Sulphate of iron is said to be good.

Dr. Frost. This disease has damaged Phelps county to the amount of $10,000.

Q. I wish to know something of the New York experiment station, as we think of one here?

A. I was one of the class that advocated a diffusive system instead of one central station; that is, I advocated the plan of establishing several over the State managed by practical farmers. This would bring our farmers to them and more interest would be taken.

Secretary Sanborn. The plan of the gentleman from New York is doubtless a good one. Germany has about eighty, I believe, and she is, in territory, larger than Missouri, of course, but yet a small country in extent. We are not ready just now for the diffusive system, as we are not ready to meet the extra expense, and we have not the men educated for the work. In fact, it is now hard to get one organized in each State. There we will educate men for the work and both systems will be needed in the end. I am sorry the question did not come up earlier, so that we could have discussed it more fully, but the chairman has called time.

Dr. Paquin followed with a discussion of animal diseases, the substance of which will be found in the report of a previous meeting.

Q. What do you think of ashes, soap and salt as a cure for hog cholera?

A. They are very good vermifuges, and prevent diseases due to parasites, which are often mistaken for cholera.

Dr. Frost said that he had used copperas and slops for this trouble very successfully.

The meeting then adjourned until 7 P. M.

EVENING SESSION.

The first speaker was Mr. Fulbright, a member of the Board from Laclede county, on

ORGANIZATION, EDUCATION AND CO-OPERATION OF FARMERS.

BY JAS. A. FULBRIGHT, ESQ.

Coleridge defines organization thus: What is organization but the connection of the parts in and for a whole, so that each part is at once both means and end. Organization is the proper placing or adjustment of the elements so as to form or complete the structure,

and that each element or part shall become an efficient factor or means in accomplishing the desired end or object. In the first place I desire to illustrate the necessity and importance of a thorough and systematic organization of the vast multitude of agriculturists, not only of our own State but likewise of the whole United States. It is a fact fully known and universally acknowledged by every intelligent farmer, that in union there is strength, and that united we stand and divided we fall, is as true with respect to the agricultural classes as it is, to families States or nations. In order to efficient work and ultimate success, in any department in life or business, thorough and systematic organization is indispensably or absolutely necessary. Take as an illustration of this propoposition the magnificent railroad system of our own as well as of other States. Every factor or element connected therewith is an essential element of success. Every officer from the president down to the yard master and switch tender contributes his part to the desired end—ultimate success. Every factor from the lowest to the highest, and *vice versa*, is an indispensable element of success. They are properly placed or adjusted so as to accomplish the object. The merchants' exchange furnishes another illustration. The telegraph companies, the Adams Express Company, the Army of the United States, the Firemen's and Engineer's Association, the national banking system, and the insurance companies of this and other States speak in thunder tones upon the necessity and importance of systematic organization among the farmers of this country. Every other class of men, or nearly so, are thoroughly organized. Does not the success of the different organizations above mentioned teach us the importance of thorough systematic organization among the agriculturists of America? Can we afford to neglect this chief element in our success any longer? I think not. Shall we longer neglect our own interests and the interests of our children and of coming generations, while upon every hand we are warned and admonished to act wisely? We know that we are continually and sadly overreached by organized effort. Will we not be forced to organize in self-defense or perish on account of our own stupidity? If we will sit supinely upon the stool of inactivity and suffer ourselves to be cheated and unjustly taxed on every hand, we have no right to whine or complain. A thorough organization of this country, forming as it would the grandest brotherhood of toilers on earth, with mutual relations, dependencies and interests, would heighten our appreciation of, and interest in each other; but as long as we continue to act independently of each other we can reasonably expect nothing but the most signal failure. Who has a right to enjoy the fruits of his toil?

Reason and intelligence answers, the farmer! Why does the farmer enjoy but about 3 per cent. of his just earnings, while other men enjoy the other 97 per cent.? Because others have formed themselves into vast and strongly organized bodies, that vampire like, are sucking the very life-blood from vitals of the vast agricultural body in this country. How long will this unhappy state of affairs exist in our midst? I unhesitatingly answer that the end of this evil—want of organization—cannot come until we enter upon the work of a thorough and systematic organization of all the forces; not until we shall be able to apprehend more fully our rights, our needs, and our obligations to ourselves and our children; not until we thoroughly organize for our own protection. Our first duty is organization.

EDUCATION.

To educate is to teach, instruct and discipline. In my judgment there is no reason why the farmers of this country should not be the most intelligent class of people in it. I ask, in the name of justice and common sense, why the men who create nearly all the wealth of this country should not enjoy as much time for improvement as any other class? When we organize ourselves for the protection of our material interests we will be enabled to so systematize our work as to afford us more time for intellectual development and improvement than can possibly be enjoyed by any other class of persons. It is an acknowledged fact that we are the wealth producers; if so, why is it that we are forced to rise at five o'clock in the morning and labor incessantly every hour of the day for a bare subsistence? It is absurd, unjust, unreasonable and un American. What we need is, to fully understand our rights and to assert them in a manner that can not fail to cause all men to recognize them, and thus place ourselves on that elevated plain that will enable us to make the needed improvement in point of intellectual development. The first thing (after organization) is to learn to systematize our work on the farm. There is a vast multitude of farmers who perform an enormous amount of work and have a world of worry, simply because they have no system. They have no well matured plan, but everything is done in a sort of haphazard way. The plans for each day are arranged in the morning before the forces can be brought into active service. They have no place for anything, and hence nothing in its place; rather than a place for everything and everything in its proper place. There needs to be a thorough and systematic organization of the forces or hands employed on the farm. Everything should be done according to a well digested plan or system, done at the proper time and in the proper manner. A point upon

which our farmers need instruction and reformation is in reference to the practice of overcropping. There is no estimating the amount of time wasted and money lost, by an effort to cultivate more land than we can cultivate as it should be done. We could easily learn that one acre of land properly-handled will yield a greater per cent. of profit than three or possibly than five acres well handled, as a vast quantity of our land is handled. One of the great barriers to our success lies just here. What we need is a judicious arrangement of our crops so as to give us ample time to give each the required attention. If we would succeed we must have the right kind and quantity of implements and take the proper care of them. There is no question but that in some parts of our State there are more implements rusted out than are worn out. It is far cheaper to build sheds for, and paint our implements when they require it, than it is to let them rust out and buy new ones so often. There are many practical lessons in store for us if we will only receive and profit by them. It would be greatly to our advantage if we would handle a less number and a better grade of stock. It costs us as much to feed and care for a poor grade as it does to feed and care for the best, and we all frankly acknowledge that good grades yield a greater per cent. of profit. Therefore, to own a less number and give them better treatment would cost us less time and feed and bring us more money. We stand greatly in need of instruction on the subject of finance. It is a startling and lamentable fact, that from one-half to two thirds of the lands of our State, (or at least as far as I have examined), are under mortgage. The States of Kansas and Illinois are in a worse condition in this respect. This, in my judgment, is one of the most dangerous tendencies of our civilization. The ownership of the farms of this country by the farmers themselves is the only sure foundation for the prosperity of our people and the perpetuity of our republican institutions. Take from the people their homes, and gradually but surely every spark of patriotism will be extinguished. When the homes of this country pass into the hands of a landed monopoly and the tillers of the soil become tenants upon their original homes, the name liberty will be an insignificant and unmeaniug term. Farmers must learn "that out of debt is out of danger." To the extent of our indebtedness we are servants.

We are free only when "we owe no man anything." The growing tendency among farmers to heap up immense fortunes in a few brief years by speculating in stock or some other commodity has a very dangerous tendency and destructive effect. We would better learn that gradual development is more healthful and is far the safest and most satisfactory in the end. But a few days since, a man in my neighborhood sold a farm for about $9,000, paid off his mortgages and had from

$400 to $800 left. He is one of the speculating farmers referred to above. There is a vast number of my neighbors as well as yours on the same road and it is only a question of time and they too will be left homeless and helpless in the midst of a horde of heartless speculators. The borrowing of eastern capital, and mortgaging our farms to secure the payment, with the idea that we can engage in stock speculation, or anything else, while others set the prices on our stock and every other commodity in which we deal, is *stupidity* doubly *sublimated* and *rectified* to all intents and *purposes*. We would better keep our homes; systematize our work; buy only suitable implements and take proper care of them; cultivate our lands thoroughly; utilize all the products; keep ourselves clear of debt and our farms free from mortgages; be content with gradual growth, healthful development, and permanent prosperity. There is one more point in the educational department to which I desire to direct your attention. We need a broader, a more comprehensive view of our political relations, and duties, or obligations. We should be enabled by an increase of intelligence to know and fully realize that we are responsible in a great measure for the *unhealthy* and *unhappy* state of affairs that now *surrounds us*. We have the power to right all the wrongs, and adjust all the elements if we only had the proper cultivation of the brains we possess. We are naturally as intelligent as other men. What we need above everything else is an education that will place us on an equality with any and every other class of men. We must learn that when we wish a thing done we must GO, but if NOT, we can do as we have in the past, we can send some one else. When we desire legislation that will make us equal with other clases before the law, we must send men to legislate for us whose interests are identical with our interests. As long as we elect men to legislate for us whose only interest in us is *self-interest* we have no right to complain if our interests are neglected. What reason is there for us to elect men to legislate for us who have no interest in our success. It is the boast of sharpers and tricksters that we have not intelligence enough to recognize and defend our own interests.

When monopolists and corporations have any matter of interest in legislation they send or hire men to attend to it for them—men possessed of intelligence and skill. We must educate our sons so that they will be able to compete with the shrewdest men in other associations.

The idea that we must tamely submit our dearest interests and most sacred rights to the dictation of a class of men whose interests are diametrically opposed to our interests is too absurd and ridiculous to be entertained for a moment by men of intelligence and culture. Of

all the subjects in which we are at present interested, the education of the farmers of this country seems to me to be the first in importance. Upon this depends the happiness and prosperity of the American people and the perpetuity of their republican institutions.

CO-OPERATION.

The act of co-operating, or of operating together, or concurrent effort or labor. The necessity of joint or concurrent effort is recognized by the State, the school, the church and every successful business association in the land. The farmers of this country are the only class of business men that have thus far failed to fully recognize the importance of co-operative effort. It is the easiest thing imaginable for those who act together to wield a power over us that we are unable to resist as long as we act independently. We will be forced to act in an associated or concurrent manner in order to protect our own interests. The great curse of our age and country to day among the agriculturists is a want of co-operative effort. There is scarcely one in one thousand of the farmers of this country that has given the subject sufficient study or thought to fully understand the magnitude or importance of it. No class of men can long succeed in business at present without concert of action. What is the state of the case with the farmers of this country? Go to any market in the country and observe the procedure —when the farmer brings his products to the buyer, see him stand hat in hand and wait the pleasure of the purchaser. Who prices his grain or his stock? Does he have a word to say in reference to the whole transaction? Not a word. Some one else, or rather some combination or co-operative body of men, decide just how much the farmer is to get for every bushel of wheat, every pound of pork and every other product of the farm. Then, when he has allowed the grain or stock dealer to price and take the products of his muscle and his soil, follow the farmer to the hardware, dry goods or grocery store and observe what a wonderful influence he exerts in purchasing his goods. What does he have to do with prices in this case? Nothing at all but to pay whatever the merchant demands. Some one is ready to say, well, he need not sell his products at the prices offered, or pay the prices demanded, if he does not want to. I answer that it is not true. But it would be true if there was that concert of action that should exist among us. The prices are all arranged for us on both hands, and all that we can do acting independently as we have done, is to submit to the program as made out for us by our masters. How can we remedy this evil and remove the curse? I answer, by co-operation. To illustrate this I will take my own county. I will say that there are 2,000 farmers; they are thoroughly and systematically organized, and have had time since

the completion of the organization to acquire sufficient knowledge to co-operate or act together in buying and selling; they are at present more or less indebted, and are therefore compelled to dispose of the products of their farms at a certain season, because their obligations must be met. Well, suppose they have a warehouse of sufficient capacity to store the products that they are forced to dispose of at any given period. Pork is worth 3 to 4 cents per pound, wheat is worth 60 cents per bushel, etc. Could not these men from the different parts of the county bring their products to Lebanon or other points, and store them (having ample insurance on the property) and get an advance on them of more money than they could realize in the market for them. Certainly they could. Why? Because this pork that is stored there will bring from 10 to 12 cents per pound in bacon, and the wheat cannot possibly bring less in the market than the present price, therefore, any man having the means would gladly make an advance on the products that would enable the farmer to meet his demands, and by having an agent at St. Louis, to whom we could ship our products, we would realize all that it would bring in the market.

That same agent or another in St. Louis would buy our goods at wholesale and ship them to us cheaper than any merchant in Lebanon could possibly buy them. And we would thus make money on our sales and save money on our purchases, and would soon be out of debt and begin to realize the worth, the importance and advantage of co-operation in business. Widen this until it embraces the States, and we would stand related to the business interests of this country as they now stand related to us. We would be able to dictate terms, we should be able to do this The class of men who produce the wealth of the country ought, in a large measure to control it. Let us organize, educate and co-operate in such a manner as will enable us to enjoy the fruits of our honest toil.

At the conclusion of this address a paper was read by Prof. L. R. Taft, of the State Agricultural College.

*ORIGIN OF DOMESTIC ANIMALS.

BY PROF. L. R. TAFT.

The domestication of animals was no doubt coeval with the civilization of mankind. In the earliest historical writings we find mention

*This paper was presented without any knowledge of the fact that a similar article was to appear in this volume; hence, only an abridgement of it can be given.

made of the use by man of the ox, horse, ass, etc., to assist him in tilling the soil, for war, as beasts of burden, or for furnishing flesh or milk.

By studying the different strata of the earth, we can carry the history of these animals much further back than any written history goes, and can positively assert that they existed on the earth in a wild state long before the appearance of man. The fossil remains of these animals in the caverns of Great Britain and Italy, and in deposits in nearly every part of the world, occur in formations which antedate, by vast ages, the earliest remains of man that have ever been found. This agrees perfectly with the Biblical account of the creation, as given in the first chapter of Genesis, where the creation of the various land animals took place on the fifth day, while that of man was the work of the sixth. We merely have to refer the word "day" to a grand geological epoch, and then there will be perfect harmony between the written and unwritten stories of the creation.

When man first appeared on the earth he lived as a hunter, and probably the dog was one of the earliest animals to be domesticated. Soon, however, man subjected the goat and became a nomad, roaming about with his flocks and herds, and obtaining from them flesh, milk and clothing. Then sheep and cattle came under his sway. The ass was used as a beast of burden, as was also the camel.

We find a record of this in the remains of the cave and lake-dwellers, where the bones of man are mingled with those of the dog, cow, goat, etc., and the same thing is true of the fossil remains, all the way down through the stone, iron and bronze ages.

This surely is conclusive evidence that man made use of these animals, but man himself, in a little later day, has given us unmistakable evidence of its truth. On the earliest monuments of Babylon and Egypt, we find representatives of the various animals, showing the way in which they were used, and from these sculptures we can learn much as to the customs of those days. The implements, method of harnessing, and the various agricultural processes are there depicted, and so little change has taken place in the East during the last three thousand years, that the same implements and methods of planting, harvesting and threshing are in use there to-day as is shown on the monuments.

In the early Bible times man was an animal baron wandering about with great flocks. Mention is made of Job, who had 14,000 sheep, 1,000 yoke of oxen, besides camels and asses.

This was true not only in Egypt and Palestine, but in Persia, India and China. It did not hold true in America, where at the time of its

discovery by Columbus, man was a savage, and there were no living forms of horse, cattle or of any of the domestic animals.

The Bible view which is also held by Agassiz and others, makes the species permanent, and thus each species becomes of limited flexibility.

The general belief, which is the one held by Darwin, is that the species are the product of environment; that is that the great variation which we notice between the different species of animals, is brought about by the varying conditions to which they have been exposed.

This theory would show that our domestic animals are derived from wild species, which in turn have descended from a common stock. In some cases, however, the change has gone on, until they have but little resemblance to original type, and in others the original form has become extinct.

THE HORSE.

We are assured of the wide distribution of this animal in the early ages of the world by the fact that its fossil remains have been found in every quarter of the globe.

In America, the remains are very numerous and vary in size from that of a fox, to one larger than the largest horse we have to-day.

The earliest progenitor of the horse of which we have any trace, had four functional and one rudimentary toe in front, and three toes behind, but it is probable that the original horse had five toes on each foot. This can be accounted for by the fact that in the Tertiary Period the land in America which was undoubtedly the original home of the horse, and where most of these remains occur, was soft and swampy, and by thus widening the surface of the foot, the horse was kept from becoming mired. As the land became drier, one after another the toes disappeared, until we reach the horse of historic times, with a single toe on each foot.

One strong reason for believing that the original horse had five toes, is that they sometimes revert to prehistoric types, and we occasionally hear of a horse with three digits on the front feet and of others with two on each foot.

The origin of the domestic horse is unknown. Closely allied to it are the Zebra, Quagga, Ass and Kulan, all of which now occur in a wild state, but although seven varieties of horses are mentioned by naturalists it is probable that they are all feral, or are merely horses that have escaped from domestication.

The wild horses of North America are supposed to be descendants

of the horses abandoned by De Soto in 1539, while the vast herds which roam the pampas of South America are also probably of Spanish origin having been liberated at the abandonment of Buenos Ayres in 1537.

On the high plains north of the Caspian Sea are large herds of wild horses called Tarpans. They are feral, and are descended from the horses liberated during the seige of Azof about 1700. They are of small size, dun in color, with short mane and blunt nose. Some herds are bay, others are white and still others of a black color, roam the steppes of Asia.

They are smaller than the domesticated horse, with larger head, more hair, and with a dorsal stripe. Since our tame horses, allowed to run wild, will revert to these characteristics, it is believed that they are all feral.

There are vast herds running wild in Central Africa, and recently a new form has been discovered in Central Asia, which is unlike any of the other wild tribes, and which approaches very nearly the domestic horse. It has been named *Equus Przewalskie.*

It will thus be seen that the source from which the domestic horse has come is shrouded in darkness, and probably the wild race from which it has descended is extinct.

History first refers to the horse in Egypt, about 1900 B. C. In the very earliest Bible times, no mention of the horse is made. Although Abraham, Isaac and Jacob had vast herds and flocks, they had no horses, and it is not until Joseph became governor in Egypt that horses are spoken of.

Whence they came no one knows. Some claim that they were captured from wild herds in Africa, and, after being tamed, sold into Egypt; but the general belief is that they were descended from the wild forms then found in Central Asia, and were taken to Egypt by the so-called Shepherd Kings, who conquered the country at that time.

At this time, and for nearly three thousand years, the horse was not used in agriculture, its chief service being in war and hunting. At the time when the Jews left Egypt they were pursued by 600 chosen chariots and all the chariots and all the horsemen of Egypt.

It was not until 500 years later that the Jews used Chariots in war, but in the time of Solomon we read that they had 1,400 chariots, 12,000 cavalry and stabling for 40,000 horses. Most of them were obtained from Egypt. Before this time they had not been allowed to use horses, and were obliged to hamstring all of those taken in war.

The Egyptians exported horses to Greece, and probably to Rome. From here they soon spread all over Europe, and when Cæsar invaded

Britain, about 70 B. C., he found the natives using horses and chariots in war.

There were few horses in Arabia even as late as twelve hundred years ago, for we know that Mahomet had but two in his army; and although in one of his campaigns mention is made of 24,000 camels and 40,000 sheep, no mention is made of horses as part of the booty.

The horses of the United States are for the most part descended from animals brought from England, with an infusion of French and Arabian blood.

CATTLE.

Our domestic cattle are generally spoken of as belonging to the non-humped species, *Bos taurus*, while the humped form known as the Zebu, or sacred cattle of the Hindoos, are classed as *Bos Indicus*.

Cattle are mentioned in the Bible in connection with the old patriarchs, and from sculptures on the Egyptian monuments which date back to 2100 B. C., it is evident that some of them were of the humped species, and also hornless.

Scattered over Europe are fossil remains of three non-humped forms, and our present breeds probably have descended from these. One of them, known as *Bos primigenius*, in the time of Cæsar, roamed the forests of Northern Europe under the name name of Uri, or Urochs. They are described as of enormous size, almost equalling the elephant, with which they lived in the early ages. The remains in Switzerland show that they must have been domesticated by prehistoric man. Old English writers make frequent mention of these cattle, describing them as white in color, with a thick mane.

With the settling of the country they slowly decreased in number, until now they are found only in a few of the large English parks, where they have been carefully preserved. The eyelashes and tips of the horns are black, the inside of the ear and muzzle are reddish brown, while all the rest of the body is white. The mane has almost disappeared, and owing to the change of climate and surroundings, they have become reduced in size. If taken while young they can be easily tamed.

From this wild species the breeds now known as Holstein, Friesian and Pembroke, besides other mountain breeds of Wales have come.

A second wild form was *Bos longifrons*. They were small in size, with a short body. The Swiss cave dwellers domesticated them, and at the time of the Roman occupation of Britain they were in a domesticated condition there. In color they varied from a light gray to a

reddish brown. Most of the Swiss and Highland breeds, as well as several Welsh breeds, came from this species.

The third form, known as *Bos frontosus*, at one time roamed over all Europe, and is supposed to have given rise to the mountain breeds of Norway, and from these the Channel Islands breeds undoubtedly came.

Over fifty distinct breeds have been described, and all came from the above mentioned species, either directly or by crossing.

SHEEP.

The origin of our domestic sheep is shrouded in mystery. They have come from a number of wild species and the Mufflon of the Caucasus, and the Siberian Argali were undoubtedly made use of, but as to the others nothing is certain. These wild forms were domesticated in the countries where they lived, and from their union the breeds of to-day have been formed.

The earliest domesticated form, as shown by the remains in the lake dwellings, was small, with long, slender legs and horns like those of a goat.

The present domesticated breeds have a wide range and differ greatly from each other. One Eastern form, known as the fat-tailed sheep, have broad, flat tails, so loaded with fat that they ordinarily weigh twenty-five pounds, and sometimes attain the enormous weight of 150 pounds.

As they are considered a great delicacy, a small truck, or wagon, is placed under them, on which each sheep draws its own tail about, that it may not be injured by dragging over the rough ground. Another form has two masses of fat on its rump, while the tail is very small. There is a considerable variation in the horns, not only in shape but in number. Sometimes they are absent, or they may, on the other hand, number from four to eight. As a rule, when more than two horns are present the fleece is long and coarse. The wild sheep have a covering of long hair, under which fine, short wool is found which becomes longer in winter. Under domestication, wool takes the place of the hair. To Spain and Portugal we should give credit for the first attempts to improve the wool of sheep.

HOGS.

It has been settled beyond a shadow of a doubt that the breeds of swine can all be included within two species. One of these is *Sus scrofa*, or the common wild boar of Europe, which even now roam wild over some parts of Northern Europe.

For centuries animals of this species have been under the influence of domestication, but they are still characterized by the great length of their noses, ears, legs and tushes, as well as by the general proportions of their bodies.

The other species is spoken of as *Sus Indica*, but the animals domesticated are commonly known as the Chinese breed. They have a short nose, small and erect ears, round body, a hollow back, and are generally covered with a thin coat of fine black bristles. They soon reach maturity and fatten easily.

Chinese scholars claim that this form has been under domestication there for nearly five thousand years. The Neapolitan, Hungarian and other breeds of Southeastern Europe, are of Chinese origin. The present improved black breeds have for the most part been produced by crossing the Neapolitan with the English hogs, while the white breeds, as a rule, have been developed by judiciously crossing the English with Chinese hogs.

Thus it will be seen that our domestic breeds of animals have, by careful selection, crossing and feeding, been developed from wild species, many of which were utterly unlike the forms of to day.

This was followed by an illustrated lecture on plows by Professor Sanborn.

Mr. Bishop being called upon for a talk, said that he sowed the first clover used in this locality, and we find the chinch bugs will not eat. We learned during this dry chinch bug year the value of clover, and have all learned that we get satisfactory returns. We should grow less and better grain. I have grown twelve tons of clover on three acres. This was not done by accident, but was produced by spreading the wash of my cow yard over the ground. I find that we must use manure.

Our barns were built at first on the side hills to allow the manure, etc., to wash away. I used to do well but I have taken the Missouri distember; leave my tools out of doors and I have, in short, become lazy.

Look at the dry goods boxes and rail fences which are nearly whittled to pieces by the loafers. But I do not know as this is any more Missouri than New York distemper. I used to make money on the farm, but now I don't. I notice my wife up at 5 o'clock in the morning and until 11 at night, and I wonder if she would have married a farmer if she had known what she now does, but she did not know it when she got me. Our women are not aided by the farmer as they should be.

MEETING AT MARSHFIELD.

The board met at Marshfield, Webster county, December 22d.

Mr. Hubbel was chosen chairman.

Secretary Sanborn was the first speaker introduced, who discussed the question of "Farming for Success," outlining the changes desirable in our systems of farming. This occupied the forenoon and an adjournment was taken until 2 P. M.

AFTERNOON SESSION.

The first exercise consisted of a number of questions on the morning lecture, and covered the subject of grasses, manures, etc. The secretary of course could make no report of these questions as he was kept busy answering them.

The next exercise was the usual address by Dr. Paquin, on the subject of "Animal Diseases," and the following line of questions was asked:

J. B. Jones: Please give us the cause and remedy for blackleg.

A. It is due to a ferment germ; I cannot give a very satisfactory answer; remedies are uncertain; changing to a poorer pasture is often beneficial; they vaccinate against it in Europe.

Q. Did you ever know of a poor steer being affected with this disease?

A. Good and fat young animals are most likely to have it.

Q. Give us a cure for hog cholera?

A. This same question is always coming up, showing the responsible position science occupies when it undertakes to explain and cure these diseases. Our State may do much good by founding a laboratory

for the study of these diseases of which we know little. Disinfection is the only rational treatment as preventive of unknown infectious disease.

Mr. Montgomery: I lost a Poland China hog last winter, and a neighbor opened it and found a worm or snake fourteen inches long over the shoulder.

Dr. Paquin: This is the first time I ever heard of a snake in a hog.

Q. How shall we cure garget?

A. Use bi-corbonate of soda internally. This trouble is an inflamation; a poultice and an ointment of iodide of potassium and belladonna is good.

Mr. ———: I have twenty-five shotes which cough considerable, but seem to be well.

Dr. Paquin: If simply a cough, give from five to ten grains of camphor and two drops extract of belladonna in the food.

Q. Is there such a disease as measles among hogs?

A. Yes; in Europe it is found associated with a minute parasite, and affects the skin. I know of no good description of its existence in America.

Mr. ———: I notice an inflammation of the eyes among horses, the eyes becoming white; seem to go and come.

Dr. Paquin: It is periodic opthalmia; is constitutional and hard to treat. Calomel given, and blisters applied on the cheeks near the eyes, with an eye wash consisting of fluid extract of belladonna, five drops; sulphate of zinc, ten grains; iodide of potassium, ten grains soft or rose water, two ounces, should be used. Blindness usually comes sooner or later.

Q. What are the causes of this periodical opthalmia?

A. I cannot say with certainty, but it is hereditary, and this is the most common cause.

Q. Does not indigestion cause it?

A. I think not; I see no sound reason for thinking so.

Mr. Fulbright was next introduced, and read a paper on "Organization, Education and Co-operation," which will be found in the report of a previous meeting.

Mr. ———: I move that this body ask our Senators and Representatives to favor an appropriation for our Agricultural College for the education of our farmers.

Deffered, for action, to their club.

Mr. Rushmore of New York followed with a short talk on dairying. He said the subject is so full and the hour so late that I propose to come here again if you desire and give a talk on dairying.

Mr. Bodenhammer again suggested that we take action on the motion concerning the appropriations.

Mr. Smith moved that we request our Senator and Representative to vote for the appropriations needed for the Agricultural College and State Board of Agriculture.

Mr. Sanborn remarked that he was acting as their agent in handling their property and could say that the property could be much more effective if aid was extended to it. At the same time he very much preferred to hear their criticisms if any one felt that they were needed, and would be happier to know any opposing reason to the College or Board. He hoped and was anxious to hear any objections that might exist.

The motion was unanimously carried.

Prof. Taft then gave a talk on FRUIT GROWING. He said that many fruit growers find when their orchards are in grass especially in case the soil is poor, the trees set much fruit, but the fruit will be small. Such soils must either be tilled or manured. In case the soil is very rich the grass in the orchard will restrain the growth to the advantage of the orchard.

Judge Jones: Does the Duchess do well?

Professor Taft: When grown on the Quince it is one of the best pears.

MEETING OF THE BOARD AT CARTHAGE.

CARTHAGE, December 23, 1886.

Met at 10 A. M.

J. H. Fulbright, Esq., in the chair.

Secretary Sanborn gave his usual explanation of the work of the Board.

Professor L. R. Taft was then introduced, who spoke of the experimental work done by the Horticultural Department of the Agricultural College.

Among our new varieties of strawberries the Woodhouse seedling in color, quality, productiveness and firmness promises well.

The Jewell, which has been so much praised, has not done well on our soil and its productiveness and quality are but ordinary. In quality the Henderson was good. In quality the Belmont is good but it produces only fairly well. The Emerald is very good but Woodhouse seedling of the new kind is the best and the Belmont second.

Among the Raspberries given up by us as unworthy are: The Cuthbert, Caroline, Superb, Lost Rubies, Reliance and Brandywine, none of which have proved sufficiently productive to warrant further trial.

Among the good varieties are: Hansell, Turner, Gregg and Souhegan. The Marlboro has not proved productive, although the plants are healthy and the fruit of a large size. Shaffer's Colossal is hardy and exceeds both in size and quantity of fruit—all red raspberries. We find the Gregg the best of the black caps.

The Carman, among the new sorts, is a promising one, as it is earlier than the Gregg and exceeds the Souhegan in abundance of fruit.

The Snyder, Taylor's Prolific and Western Triumph are among the most desirable blackberries. Of the new varieties, the Early Cluster, Wilson Junior and Agawam are hardy but not sufficiently tested as to their productiveness to warrant a report.

VEGETABLES.

Peas.—We have tried many novelties in the vegetable line and and a great similarity of sorts, and identity in all observable points. The Alaska is new, productive and hardy variety. I get about ten more peas from a hundred pods of this variety than any other. The Rural New Yorker is a good early pea but not up to the Alaska. Among the productive sorts I have the Bliss, Abundance and Hosford's Market Garden Pea, which have a peculiarity of sending up four or five branches from each vine, and twenty five pods on a single shoot, or from sixty to seventy five or one hundred pods on one plant. I plant a little farther apart on account of this peculiarity of growth.

Beets.—The Eclipse has small leaves and a round body. I got the seed of the Eclipse and Egyptian varieties from the same man and found very little difference between them except that the Eclipse was the earlier. Last year they were quite distinct.

Celery.—We have tried various methods of cultivation. Our best success in this dry year was in a cold frame, and Crawford's proved very valuable. In these frames we could water them conveniently, and found our less productive sorts much more productive when grown in this way, than better varieties were when grown in the open air.

ORCHARD.

We have over one hundred varieties of apples and twenty varieties of plums.

Pears.—We have five forms of Japanese pears, and of these, three varieties promise well. They were planted in 1881 and in 1885 produced over a peck per tree, although growing in a sod. They are yellow or russet in color. Madame Von Siebold seems to be the best. The quality is too poor to warrant its use as a table frutt, but for canning it will prove very valuable. The other varieties are smaller, of a bright golden yellow color and of fine shape. Their quality is poor, yet the very best for preserving. They are very hardy and productive, and for preserving they are regarded as the coming pear. The Kiefer bore heavily, in fact too well, and when ripened carefully the quality of the fruit was very fair. It is medium in early bearing.

Apples.—The Stark and Gono bore a few at five years after setting.

Q. Is the Stark a desirable variety?

A. We have only two young trees and cannot as yet say, although I think it will do.

Q. What varieties would you advise for eating apples?

A. Willow Twig and small Romanite are among the best keepers —Ben Davis for shippers. The Jonathan and Huntsman are improving fast in public favor.

Q. Which keeps the best, Willow Twig or Ben Davis?

A. Willow Twig.

Q. I find the tree-cricket injurious to raspberries often killing them to the ground. Is it so with you.

A. We have them, but little harm is done. Did you examine roots? Insects work there and do the damage oftentimes. If you wish a work on insects Saunders' "Insects Injurious to Fruits," gives seventy-five species as attacking the apple, and is the most valuable work for fruit growers that I know of on insects.

Q. What are the best varieties of grapes?

A. I used Ives Seedling for early, followed by the Concord, and for late, the Elvira.

Mr.——. I call the Worden a good grape.

Prof. Taft. Our Russian mulberry trees served the purpose of keeping the birds eating its fruit, which it bore by the bushel. Our strawberries and other fruits were by this means protected. I like the mulberries both cooked and uncooked.

Mr. ——. I find that the paper sacks placed over grapes are torn by the birds.

Prof. Taft. Yes, but if used when the grapes are no larger than shot the rot is prevented and the grapes are nice, as it seems natural for them to grow in the shade. I never found the sacks troubled by birds, however.

Q. Did you experiment with tomatoes?

A. Yes, the cardinal was found a good shape and quality for market. We also used the Perfection and Acme, and find the latter the best of a dozen varieties for early use, being more regular.

Q. What is good for blight?

A. The best thing is to promote a healthy growth and prevent heavy bearing. It is a fermentation of the sap due to *bacteria*. If the tree is ruptured by frost or blistered by the hot sun the disease is favored. A poor growth gives rise to scab which also favors blight, while good food giving a normal growth is the best preventative.

Mr. ——. Tell us how to prevent curculio.

Prof. Taft. By jarring the tree and catching them on a sheet, or by allowing the hogs to eat the fallen fruit. Paris Green is sometimes sprayed over the trees, and is also used on apple trees for the coddling

moth. To be a sure preventive the first application should be made soon after the fruit sets, and once or twice as the season advances.

AFTERNOON SESSION.

Dr. Paquin was the first speaker who talked on "Pregnancy and Parturition in Cows and mares." He said that females that are highly fed are more apt, than others, to be troubled during and after pregnancy.

Milk fever (a kind of sudden paralysis), is one of the most common troubles in the cow. Cold water applied by means of a wet blanket is one of the most certain and the best improved method of treatment. This treatment is common in Europe and I have used it successfully. Purgatives are also used and are valuable assistants.

Parturition is often very troublesome, and I have seen mothers delivered with great trouble and in a most cruel manner. By using the hand carelessly and nervously the animal is excited, and constriction of the parts occurs, which is caused by inflammation and consequent swelling, and your arm feels its narrowed area. The result is the young is discharged with even more difficulty. In such work the hands and arms should be oiled; use plenty of time and exercise great care.

To turn the fœtus, push the whole subject back into the womb and and gently turn the limbs and head and bring in natural position. Oil is sometimes injected to soften and smooth the parts, especially when the difficulty has been standing for a long time, and also in breach presentations, in which case the hair interferes greatly.

The method of cutting the young up in the womb when necessary was discussed at length by Dr. Paquin.

If the placenta is retained, you can oil your hand and insert it into the womb and loosen it at each of its points of attachment. This operation can be, as a rule, easily performed, and much as you would unbutton a coat.

In reply to a question the doctor said: "In giving medicines for chronic cases of impaired digestion, it must be remembered that one dose is not enough."

Mr. ——. We very frequently see horses doing poorly that seem to have no disease.

Dr. Paquin. It is sometimes due to poor teeth, where they cut the jaw, or badly masticate—food being eaten without mastication—and

impaired digestion is the result. In such cases filing the sharp edge of the teeth is necessary. If you want a good tonic, get sulphate of iron, a bitter tonic of gentian, and for the nervous assistance, nux vomica.

Mr. Fulbright followed with his paper on Organization, which will be found in report of the meeting at Rolla.

Secretary Sanborn then discussed three important factors in our farming requiring radical changes, after which an adjournment was taken until 7 P. M.

EVENING SESSION.

The first speaker introduced was Levi Chubbuck, of the *Rural World*, who gave a short talk on "County Roads."

Dr. Paquin followed with a discussion of the "Germ theory of diseases."

J. W. Sanborn gave an illustrated lecture on the "Plow and Plowing.

MEETING OF THE BOARD AT LAMAR.

An institute meeting was held at Lamar, Barton county, Missouri, January 24.

AFTERNOON SESSION.

Dr. Paquin addressed the audience first—subject, "Nature and prevention of bowel troubles," special attention being given to the disease called dry murrain, which is inflammation of the third stomach.

Q. Why is it that young cattle are affected by this disease more than older ones?

A. Adult, and even old cattle, get the disease as well as young ones, but adult cattle are accustomed, and are more able to digest the hard food than the younger ones, which have not been long on such food and have not the power to digest sufficiently; hence the latter class take it much quicker.

Q. What is the cause and prevention of dry murrain?

A. I have explained that it was caused by feeding on dry, indigestible, woody or fibrous food, especially when we change suddenly from a soft to this dry food, frozen or withered grass, astringent leaves or roots, etc.

Q. What is the remedy?

A. Soft-cooked food like oat meal, oil meal and a small quantity of good timothy hay, if the animal will eat it. Give raw linseed oil or aloes, plenty of good water and occasional injections of soap suds to hasten waste matter from bowels. Give twice daily one drachm of nitric or sulphuric acid in two or more pints of water, well mixed.

Q. How do you spay cattle, and when?

A. If to make beef, spay at about six months of age; but if you desire to produce milkers, spay when the cow gives the most milk. This will probably be about a month or more after calving.

Mr. ——. A man came through here cutting beneath the vulva to spay calves. Does that prevent breeding?

A. No; organs cut there will not prevent the descent of the eggs from the ovaries into the womb, and consequently the operation may be classed as worthless.

In his address he gave many prescriptions as preventives of diseases.

MEETING OF THE BOARD AT KEARNEY.

An institute meeting was held by the Board at Kearney, Clay county, Missouri, December 27, 1886.

Prof. J. W. Sanborn was the first speaker, and explained the object of the meeting, gave an outline of the work of the Board, etc.

W. H. Arnold, Esq., of Kearney, Missouri, followed with an address on

MIXED HUSBANDRY.

BY W. H. ARNOLD.

Fellow-citizens and Farmers of Clay County: Being reared in your midst and feeling a deep interest in the welfare of all, and especially in that calling to which I was brought up, the farmer, I will offer a few thoughts in connection with said calling, which I hope will not be uninteresting. For a topic I shall select the subject of

MIXED HUSBANDRY,

and in the selection of this topic I am aware that I shall reach a point in my conclusions that all will not agree with me. However widely therefore we may differ, it is by investigation that we learn and come to a correct knowledge of all things. Of the two first men who undertook farming or husbandry, one proved a success and the other a failure. One was a keeper of sheep and the other was a tiller of the soil, and whether they practiced what we call mixed husbandry or not, one thing is certain, one of them missed the true source of every man's success in every calling, and that is faith in God. In order to come more directly to the subject, we find in nature two characteristics, one widely different from the other—that is, variety and uniformity. In

entering the field of nature, we are on one hand struck with the unlikeness of everything we see. Of all the beauties that open up before our vision, no two are alike. The corn producing its fruit at its side, the wheat on the top, the oats, the rye, the barley, all yielding their fruit above ground, but all different. Again, we behold the potato, turnip, the rutabaga, the parsnip, the ground pea, or peanut, and a great variety of nature's productions under the ground, that are as widely different as the first named, and when we note that one kind of vegetation produces sweet and another sour; one produces white and another black; in some the variety is not so marked, and in others it is endless almost, as in the clover leaf. Then again on the other hand, we behold nature when she begins to put on her beautiful garments in the springtime that she begins to teem with millions of blades of grass, together with untold numbers of forest leaves, all so near the same that the architect or the scientist would scarcely know the difference, and if from reading the book of nature we may learn a lesson, let us profit by the same. When we behold in the field of nature, untouched by the hand of civilization, such for instance as the great American Desert, as it is called, or the western plains abounding in such a variety as to not only sustain the Red man, but also millions of wild cattle, buffalo, elk, wolves, wild horses, etc., we read diversity as well as uniformity.

Then taking these two principles in nature for our text, we propose to offer some thoughts bearing upon this subject; and first, in entering upon our calling as a husbandman, our watchword should be uniformity. We should be uniform in our habits in adopting correct principles in habits of industry, in the selection of our lands, in selection of everything we turn our attention to, whether it be of the animal or vegetable kingdom. Then again on the other hand nature has taught us, as well as experience, that in all our wants diversity will assert itself in every day life, even in our appetites we grow tired of the same things, in our raiment and in our labor we want diversity. Then again the ground we cultivate will tire and cease to yield her fatness in response to the husbandman; teaching us conclusively that it must have rest or change in our cropping. In order to keep up the fertility of the soil, we should observe this principle of mixed husbandry, variety of crops, variety of animals, as well as variety of treatment each of these should receive, in the proper time and under the proper circumstances. This should be done in order not only to obtain the best results, but also in order to meet the varied demands of our diversified markets. Experience has taught all practical farmers that every few years the favorite kind of stock takes a change, or the favor-

ite corn or wheat or vegetable, teaching us conclusively that if one fails we have another to fall back on.

There is another view in which we may look at this subject, which is of great importance, in fact, of greater importance than any of which we have spoken, and that is uniformity in organization. Disintegration tends to scattering. There is not an enterprise or calling under the sun where there is more than one engaged that this will not hold good. The manufacturer, the capitalist of every kind, the legal profession, the laborer, all have their organization. They stick together, they uphold one another's interest, but the farmer, where is he? In the past he had the grandest organization the people of America has ever seen, the best gotten up, the best arranged, and if adhered to to-day, the agriculturists of this country might have been occupying the position their calling demands, and yet I suppose there is some excuse; their isolation, together with their diversified wants and opinions, have been their great hindrance. And now in conclusion, as we are beginning to become recognized by the government, national as well as State, we should be encouraged to greater efforts in raising our calling up to a standard equal to that which our calling demands.

Dr. Paquin gave a talk on periodical *opthalmia*, in which he said: I have noticed more of this disease in this State than elsewhere. Perhaps it is because I have traveled over it more. I can not tell with certainty if there are many causes, and whether due direct to local causes or only to breeding. But I believe it to be due chiefly to heredity in breeding. Breeding to blind horses with periodical ophthalmia will likely produce blind horses in time, and should not be indulged in. It is a great mistake. We likewise breed to old, broken down horses with hereditary defects, and by this means perpetuate their defects. Blindness coming from an accident, as spavin that has resulted from injury sustained in jumping a fence, hard work, etc., may not be hereditary, but when blindness comes gradually without apparent cause; when lameness in a colt is caused by spavin or ringbone, that may, in majority of cases, be transmitted to the offspring, or in other words, may be inherited. The weakness of the parts liable to become affected may be inherited the same as many other things are inherited.

Asthma.—This is said to be inherited as is consumption. Hence, care should be taken in breeding, striving to avoid any such defects, as it is a hardship for a lame or diseased horse to work, besides, the difference, when viewed from a financial standpoint. The question of breeding from large to a small horse is an unsettled one. It may be safely practiced, however, if the extremes are not too great. But I

have seen large draft horses when crossed with small mares give non-symmetrical colts, and such I think is liable to be the case when the extremes are crossed.

Abortion.—The various causes of abortion and their preventatives were discussed. To prevent this trouble, the food should not be such as would impair the health of the animal, and foods which have a tendency to fatten, like corn meal, should not be given in large quantities. A change of the temperature by cold water, when large draughts are taken after vigorous exercise, may cause abortion.

Milk Fever.—Keep the animal on soft food before dropping their young, and never fatten them too much. A cold, wet blanket wrapped around the body, especially on the spine, is a good remedy. Assist with purgatives; epsom salts, for instance.

Q. I have a cow that lost her calf, and has been barren since then, although bred often. What is the matter?

A. I can not tell without seeing the animal, and might not be able to tell then. The functions of the womb is probably impaired and the animal may never breed.

MEETING OF THE BOARD AT CAMERON.

A farmer's institute meeting was held at Cameron, Clinton county, Missouri, December 28th.

James Williams, Esq., acted as chairman.

Secretary Sanborn was first called upon and gave an outline of the work of the Board, of the faults of our present system of farming, and gave a detailed account of a system that would give a greater success. The remarks were somewhat similar to those in the opening pages of this report.

Many questions were asked at the conclusion of the talk.

Q. Why not have corn follow clover?

A. The clover will do wheat more good than it will corn, as clover roots are rich in nitrogen, an important element in plant food, which wheat has a low power to obtain; while corn growing in warm weather when the summer sun hastens the decay of organic matter, and this furnishes nitrogen for corn.

Q. Why do you not sow the timothy seed with clover?

A. Because I desire to follow clover by wheat. Wheat grows in the fall and spring when little decay of organic matter is going on, and hence has a low power of gaining nitrogen, while clover has a high power, and will make a fine growth where wheat would starve for want of nitrogen. Again, clover has heavier roots than other crops, and when they decay they furnish the wheat crop with a great store of nitrogen. Thus I insist on wheat following clover.

Q. How would you apply manure?

A. Where manure is saved in open yards, it should be applied as soon as possible, as it leaches badly in open yards. On the soil it washes into the ground.

Q. How deep do you plow?

A. For our soil we plow seven inches deep, but the depth should vary with the soil. A flat cold wet prairie soil would not bear deep plowing.

Q. I have tried corn fodder and cannot afford to use it. My cattle will not eat ten pounds in a hundred. How can you afford its use?

A. My fodder is handled in a different manner from yours, and eighty-five out of every hundred pounds is eaten by my stock. I regard it as three-fourths as valuable as good timothy hay. In fact, I get as much growth from one pound of corn fodder and one pound of clover hay as I do from two pounds of timothy. It is cut up when the corn is out of the dough state and dry in the kernel. I put it in shocks six or seven hills square and it is soon stacked.

Q. How do you stack it?

A. In the same way that I stack wheat.

Q. In what stage of fattening the hog is the most profit found? At the first three weeks or during the last three weeks of the feeding period?

A. In all domestic animals fed for meat it is well known that the last period of feeding, or the period following that when the pig is virtually fat, is a very costly one. It is very costly to feed a pig after he is fat and should therefore be sold as soon as fat.

Q. How does your system of farming pay? How much does it cost to carry it on?

A. For the last three years the College Farm has received no funds from the State or elsewhere; it has saved and applied the manure made; it has saved and fed its corn fodder as stated; it has carried forward the system of rotation indicated, and it has laid out large sums of money for clearing land; for tools, and for experiment. One of the thirty or more experiments made, costing the farm over $100. The fertility of the farm has been greatly increased. This year we had thirty one and one-half bushels of wheat per acre, fifty bushels of oats and one hundred and seventy loads of hay from sixty-three acres.

I mention these facts because it is said that the distinguishing features in our system of farming are impracticable in Missouri. It may be proper to observe that the farm has not boarded its help and has paid for all its labor; the speaker's main work is teaching. Thus it is clearly seen that good methods and the economy of foods, manure, etc., are not destructive in Missouri.

AFTERNOON SESSION.

The afternoon session opened with a fine audience.

The first speaker introduced was Professor L. R. Taft, who gave an

address on *Fruit Growing*. An interesting discussion of the question followed.

Dr. Paul Paquin was the second speaker and questions of the usual order were asked him.

EVENING SESSION.

The first speaker was Capt. S. H. Corn, who read a paper on *Transportation of Farm Products*.

At the conclusion the Board was requested by a unanimous vote of the house to publish the address, and is as follows:

To no class of people are the economic problems springing from the rapid development of the railway, of greater interest than to the Western farmer. It is in the great centers of population, and in those distant countries where the capacity of the soil is not sufficient to furnish subsistence to the people, that the Western farmer must find a market for his produce. The question of how to get this produce to the distant market so cheaply as to leave a fair margin of profit to himself is the all important one to him. It is a law of political economy that when an article is produced in any country in excess of the demand in that country and the surplus finds a market abroad, the price of the entire product at home is governed by the value of that surplus in the foreign market and the cost of the transportation. Our chief articles of export come from the farm. The crowded populations of Europe look chiefly to the farms of the prairies of America for food needed in excess of the home supply. While it is true that only about 15 per cent. of the whole amount of wheat, corn, beef, pork and products of the dairy, produced annually, is marketed abroad, it is nevertheless the price of this 15 per cent. in London, Liverpool or Glasgow that fixes the values of the whole upon the farm here. The transportation of this 15 per cent. surplus to the sea board is furnished almost entirely by the railway companies, and the cost of it, affecting as it does the value of the entire product, is the chief factor that figures in the profit or loss to the Western farmer. What the great West needs therefore, most of all, is a railway service that is at once cheap, nonfluctuating and reliable.

The agricultural interests of the country are of greater importance than all others combined. Four-ninths of all the people in the United States employed in gainful occupations are engaged in agriculture;

more than double the number of all those engaged in the manufacture, mechanical and mining industries taken together. The aggregate value of the annual products of farm exceed four thousand million dollars; the grain, meats and dairy products alone furnish more than half the freight annually moved upon all the railroads of the United States. It is ascertained that about 80 per cent. of all the freight moved upon the railroads consists of food, fuel and articles for clothing and shelter. The chief business of the railway, therefore, is to distribute among the people these articles of prime necessity. Thus it is seen how intimately the welfare and happiness of the entire people are blended with the railway service, and how the continuance of our civilization under its present conditions depends upon it.

The recent expansion and development of the railway service amounts to an economic phenomenon, 33,000 miles covered the entire length of railways in operation at the close of the war, and a thousand million of dollars the capital invested. In the twenty-one years that have followed, a hundred thousand more miles have been built and and five thousand millions more of money have been poured into the service. More than a million of men are now constantly employed in operating, repairing and building the railways of the country. Since the world began no business of any kind has ever developed with such stupendous rapidity. From this fact alone it is fair to presume that the business is enormously profitable. Capital does not flow in such copious streams into reckless ventures. Making due allowance for the peculiar and ofttimes questionable methods made use of by the railway companies to acquire the right of way and the means of building and equipping their roads, and the fact that the company that builds the road usually becomes either actually or feignedly insolvent, its bonds and mortgages valueless, and its franchises absorbed by some powerful connecting line, the fact remains that the earnings of the chief lines of railroad in the United States have been so great that the companies have frequently resorted to the expediency of watering their stock so that the per cent. paid in dividends upon the *actual* stock from the net earnings of the company would not attract the attention of the people by its astonishing proportions. More than fifty per cent. of these enormous profits which have excited this phenomenal development of the railway business, and called into it such vast amounts of capital, have been drawn from the pockets of the farmer; and fully 80 per cent., levied upon the articles of prime necessity to the welfare of the people. It would seem that a business of such magnitude, fraught as it is with the welfare of the people and the contin-

uance of our civilization, ought not to be intrusted by the government to incorporated companies to be carried on for private gain. Governments early conceived it to be a public duty to furnish to their people a cheap, regular and reliable means for the distribution of letters, newspapers and books; ours extends this service to the transportation of merchandize of any kind or value in packages of four pounds or under. If this be a duty which the government owes to the people why is it not also its duty to furnish us a cheap, regular and reliable means, with equal facilities open to all, for the distribution of our food, fuel and clothing? There would be no difference in principle between protecting the citizen from extortionate charges for bringing him his morning newspaper, and for bringing his breakfast. Cheap food and fuel are of infinite more importance to the mass of the people than cheap literature. Why should the government distribute food for the mind and not food for the body? The fact is that our economic conditions have become so interdependent that supplying cheap and reliable facilities equal and open to all for the distributions of the products of the people has become a public duty, the control of which government must sooner or later undertake. Until she does so we need not expect that equal facilities will be granted to all, and special privileges to none, nor that the price of transportation will be governed by its cost to the carrier.

The power to fix the price at which the products of the people shall be carried to market is the power to levy tribute upon all the industries of the country; the powers to decree success or failure to any business; the power to build up or pull down any city and town; the power to boom or blight any locality. The giant railway companies now struggling for the mastery of this continent, possess this awful power and exercise it at will. Originally the creation of one State, afterwards gaining a domicile in others, they have become independent of the control of all. The constitution and laws of Missouri denominate the railroads public highways; yet the companies possess and operate them as private property. Our law declares that no parallel or competing lines shall consolidate; but all the lines running from the Missouri eastward have agreed upon a schedule of charges and pooled their earnings; our laws prohibit discrimination in charges and privileges; yet an iniqutous system of rebates and drawbacks was practiced until competition was destroyed by the practical consolidation of all parallel lines; and for the injuries resulting from the violation of these constitutional and statutory provisions, the citizen is relegated to his action at law in our civil courts; and the pigmy is expected to contend with the giants. The Board of Railway Commissioners are powerless,

and Missouri furnishes to her citizens no protection from the irresponsible power of the railway companies. Other States are equally at fault; every effort at State control of the railway companies has hitherto been met in the Federal courts with the objection that the State is attempting to regulate the commerce between the States, and the objection is sustained. In the Congress of the United States every bill looking to government control of the railway is defeated by the open influence of the companies, or emasculated in its passage through the one or the other house until its impotency is apparent to the whole country.

Are the people then remediless? Let us look a little further. A railroad company is a corporation created by the State for the purpose of transacting the business of a common carrier of goods and persons. By the laws creating them and by judicial decisions everywhere rendered, this purpose is declared to be a public use for which private property may be taken without consent of the owner and the power to tax may be invoked. All the railroad companies have been swift to avail themselves of these sovereign powers, and the citizens annually feel the burden of the taxation imposed to pay the public indebtedness incurred to aid in construction of railroads within the State. Thus the companies are in ethics if not in law estopped from denying that their duties are public duties, and that their franchises as subject to legislative control. The chief reason for the failure hitherto of the State to compel obedience to her laws from the railway companies, is undoubtedly found in the insufficient means provided for enforcing the penalties denounced for their infraction. A civil suit for damages by the injured party is not an efficient remedy; it only recognizes the private wrong, the injury to the individual; while it ignores entirely the higher and greater offense against the public, which constitutes the chief ingredient of every infraction of these laws. For a railroad company to return to A part of the regular freight charge collected for the same services for which B is charged the full rate, is as much an offense against the State as if it had fraudulently taken and converted B's property to its own use without his consent. It is a private wrong against B, in that it has deprived him of his property; it is an offense against the public, in that it is an attack upon the common right of all citizens to protection in their ownership of private property, and in their equal rights under the laws. For all offenses against the public committed by a citizen, the State prosecuting the offender in its own name, at its own cost, and by means of its own officers. Why should not a corporation be prosecuted the same way for its offenses against the State? Let the doing of the acts prohibited to railroad companies, and the failure to do those required of them by the statutes of our

State, be punished by appropriate fines, to be recovered by information and indictment, as the criminal laws of our State are enforced against individuals, and let the extreme penalty be forfeiture of their franchises, and a respect for the laws of the State and submission to State control, on the part of these companies, hitherto unknown, would follow, and the plea of regulating commerce between the States would probably be unavailing.

Prof. L. R. Taft was the next speaker introduced. He gave an illustrated lecture on "The Origin of Domestic Animals," a synopsis of which will appear on pages 345 to 351 of this report.

Secretary Sanborn followed with an illustrated lecture on "The Progres of the Plow and the Art of Plowing."

Col. F. D. Curtis followed and said: In listening to the admiral lecture of Prof. Sanborn on the "Evolution of the Plow." I was almost overwhelmingly impressed with a sense of the weakness of man. It is astonishing how he could so long have continued to till the soil with so imperfect an implement as has been shown. But the plow is indeed a type of the progress of human civilization. I have often made the remark that the agriculture of any people is a true measure and expression of its social, moral, intellectual and political condition.

But agriculture could not progress until other branches of human knowledge were developed. Everything meant progress *pari passu*, or with equal pace. All meant rise together. This is true of man as well as of the sciences and inventions. No man could elevate himself much above his fellows. All must be lifted up. We could not have the steam engine, the telegraph, the telephone and other inventions before the time of their appearance. Each is a concentration and expression, as it were, of all that has gone before. In them are combined all the arts and sciences necessary to their conception and construction. This is true of the plow, and it is true of agriculture. Up to a certain point all the energies of mankind were devoted mainly to the maintenance of a bare subsistence—running the machine. Never before was there so much surplus energy in the world as at the present time. Never before did man have at his disposol so much energy and and means for moral, intellectual and spiritual improvement. What is to be done with this surplus energy and wealth? It certainly should not be allowed to run to waste. It means something—indicates something for man to do besides maintaining his physical existence. He has the means at his command, not only for supplying all the needs, but the comforts and luxuries of life. I understand this to indicate that it should be used for the general elevation of mankind to a higher intellectual, moral and spiritual plane. My interpretation is, that it is

the duty of every one to strive for a higher condition of life and the elevation of men and women almost to the stature of the angels.

At the conclusion of this talk, on motion of a citizen, resolutions were passed requesting the Senators and Representatives of the counties cornering at Cameron to support an appropriation for the Board of Agriculture and Agricultural College.

On motion, a vote of thanks was tendered the Board, after which the meeting was adjourned.

MEETING OF THE BOARD AT LANCASTER.

A Farmers' meeting was held at Lancaster, Schuyler county, Missouri, January 19.

J. R. Rippey, Esq., was chosen chairman.

Prof. Sanborn gave his usual opening talk. He said that it would be more to his taste to discuss some other question, but as he looked over the present condition of our agriculture with its low yields and confessedly unprofitable condition, and then, on the other hand, considered its possibilities, the clear necessities that rest upon us so impress me that I cannot escape the overshadowing necessity of setting before you the teachings of modern science and the world's settled truths that can so radically aid you. The speaker at this point reviewed the economic relations of modern science to agriculture, and set forth a system of farming that would relieve us of the wastes of our farming and radically increase our crops.

AFTERNOON SESSION.

Mr. Sanborn was the first speaker, and finished his discourse of the morning session.

The next speaker introduced was F. W. Smith, Esq., member of the Board from Boone county, who read a paper on the "Four leading beef breeds of cattle," which will be found in the body of this report.

Dr. Paul Paquin followed with a talk on "Animal Diseases," after which an an adjournment was taken until 7 P. M.

EVENING SESSION.

Levi Chubbuck, of the *Rural World*, gave the first address of the evening on "Farm Drainage." The address will be found in this report.

Col. F. D. Curtis, of Chicago, but formerly of New York, a life-long dairy student, followed with a talk on

DAIRYING.

The speaker gave a thoroughly practical talk, the main points of which will be briefly stated.

The male, he said, is half the herd, and should be selected with great care, as this point demands more attention to insure correct results than almost any other factor in economic butter making.

Food modifies the quality of the product as well as the quantity, hence only sound food and such as will give good color, grain and flavor should be fed.

In his remarks on cheese, the speaker indicated something of the food to be fed. He favors a moderate use of ensilage, and in addition to good hay and corn fodder, he would use oats, corn and bran.

Milking should be done in a clean stable with a pure air. The cows must be kept clean, and the milker must be kind and use the utmost cleanliness. I would use strainers, he said, but should consider them as aids only, as impure milk should not be tolerated at any time. The dairy room also should be clean and dry at all times, having pure dry air. The cleanliness should extend to the tools, which require scalding, and should be kept in pure air where germs do not abound.

Setting Milk.—The milk should be set at a high temperature, as cream rises best in a falling temperature. It should remain undisturbed after setting for the best results, and should be set immediately after drawing. If ice is not available, then cold water may be used, otherwise shallow pans will have to be the medium of setting milk. It should be skimmed as it begins to turn acid, but not deferred beyond this period. The cream of various skimmings should be stirred together.

Butter.—Churning should be stopped when the grains of butter are as large as grains of wheat; the butter is then washed with water, using brine for a last washing. The tubs used for packing should be well prepared by being soaked in brine. If this is not done they will impart to the butter a woody flavor. Butter should be worked by a worker, and only so far as is necessary to mix the salt, as this will suffice to remove the brine that may have been left after being properly washed in the churn.

Butter making is a nice operation, and if you make a good article you need not go to your grocer to sell it. The market has not a sufficiency of such butter.

Oleomargarine men claim that their product is better than poor butter, but good butter is the finest product of the farm, and a health-giving food.

Now a few words on cheesemaking. Neatness is the first requsite; scalded tools and dry, clean floors; no slimy floors, on which one risks his limbs, will answer. All milk must be good. No poor milk from a careless patron should be allowed to go in. The night receipts of milk should be cooled down to 70 degrees, and the mornings milk must be cooled as low as possible before drawing to the factory, but the two must not be mixed. I have a friend in Kansas who made his cheese from instructions received from a little book. (The book was written by Col. Curtis, Secretary.) This cheese he sold for 12½ cents per pound, and is this year putting in a fuller set of appliances. Ten pounds of milk are required to make one pound of cheese, while 25 pounds are required for one pound of butter. This shows great gain for cheese.

Rennet.—This is of great importance, and I advise the prepared rennet. Put in sufficient to curdle your milk in 15 minutes, longer or shorter, according to your purposes. If you desire to hurry cheese to market, put in enough to curdle it in 5 or 10 minutes. Cut your curd early—when hard enough to cut clear with your finger. I am sure that early cutting is necessary and that late cutting is wrong. I do not find knives necessary. I do not believe in artificial coloring, as we should color by feeding, and the same will apply to butter. Early cut hay, bran, corn, etc., will give good color, while poor food, washed corn fodder and late cut hay will give the white color.

Setting curd.—The temperature should be from 82 to 86 degrees Fahrenheit, for setting. Give the curd a gentle stirring with some clean wooden utensil, and never put your perspiring arms into the curd. Be sure to keep the temperature uniform, which may be accomplished by a gentle, even stirring. No set rule can be laid down for the time to stop cooking, and without I could show you, you probably would not understand it. But a good rule is that when cooked sufficiently it will fall to pieces if squeezed in your hand slightly.

The whey should be drawn off before it sours, as if left it will cut out some of the fats and phosphates. We sour the whey to convert the sugar of the curd into lactic acid, and by this means get rid of it.

It is very important that the temperature of the curing-rooms remain constant, for if it varies much your cheese will suffer. It should never go above 70 or 75 degrees, and from 65 to 70 degrees is the best temperature.

Prof. Sanborn followed with some remarks.

W. B. Hays, Esq., of Lancaster, said he felt grateful for what he had learned here and moved that a vote of thanks be tendered the

Board. Carried. I also desire to say that we have a College of Agriculture at Columbia that is in need of support. We have $750,000,000 of taxable wealth. My share is about 50 cents on $25,000. My 50 cents is already paid back to-day. More than ten years' tax is already left here this day by the good work of these gentlemen. The test of breeds of stock by Prof. Sanborn is of great interest and importance.

Without request or an invitation from these gentlemen, I move you that our representative be requested to vote for an appropriation for our State Agricultural College. Carried by a unanimous vote of the house.

MEETING OF THE BOARD AT EDINA, KNOX COUNTY.

The Board held a farmers' meeting at Edina, Mo., January 20, 1887.

This meeting was well attended by a very intelligent audience.

Secretary Sanborn occupied the morning session with a general talk on the "Progress of Agricultural Science."

AFTERNOON SESSION.

The first speaker introduced was F. W. Smith, Esq., who gave an address on "Cattle Breeding."

Col. Curtis then presented the subject of butter and butter-making in a very practical manner. His remarks will appear under the report of the Lancaster meeting.

Dr. Paquin was the next speaker and considered the subject of "Cattle Feeding and Breeding."

Levi Chubbuck followed with his address on "Drainage."

MEETING OF THE BOARD AT LA PLATA.

The Board held an institute meeting at La Plata, Macon county, Mo., January 21, 1887.

A full house met the Board at this place and a very interesting meeting was held.

The proceedings were much the same as at Edina.

The addresses are not a repetition in full but varied to meet the local needs observed or to meet the questions arising.

It is the purpose of the Board to meet the more pressing needs of our agriculture.

I will repeat that the Board hopes to be able to secure the services of a stenographer to take the questions and answers arising at these meetings, which are often full and valuable.

Mr. Evans was called for and responded by giving a talk on "Creameries." He said: I have been through lower Illinois and find the Centrifugal separator in use in the creameries.

I saw 5,000 pounds of milk go through the separator and the amount of dirt coming out was astonishing.

By this system the dairyman has none of the trouble encountered in setting milk.

Q. Is not a small machine coming out for farmers, costing from $18 to $20?

Mr. Evans. I know of no such machine, and think that as yet none are perfected.

Col. Curtis. I regard the Danish or Weston machine as the best, but it costs $500. The first cost of this machine is more than that of the De Lavel, but it is substantial. There is another make on the market at $175, but is yet very rude and inadequate.

I believe the time is coming when the separator will be common. One great advantage is that they give sweet milk which is very desirable when feeding calves, and for other purposes.

The cream obtained by this process needs different management from that obtained in the ordinary way. I find the milk left, although

skimmed, is usually good, and there seems to be air in it left by the process. Prof. Arnold has shown us that sweet cream will make good butter if exposed to the air.

Mr. Evans. I have some experience and a theory on this question. In handling tobacco it has to go through a sweat, as other vegetation does, to keep. Cream is of vegetable origin, and if it goes through this sweat after churning all right, but it usually goes wrong, and should go through this sweat before churning.

Col. Curtis. There is more fat in butter than in the food. Prof. Sanborn will tell us how.

Prof. Sanborn said that the albuminoids in oils and carbohydrates were doubtless converted into fat.

Dr. Paquin said that the reason butter made from sweet cream will not keep, may be explained by the so-called "germ theory," which explains so many phenomena heretofore considered as mysteries, and I firmly believe that it will lead some day to the discovery of means to make keeping butter from sweet cream.

It is not *lactic acid* that causes the butter to become rancid, but it is *butyric acid*. This fact is most important because we know that Pasteur has demonstrated that *lactic acid* and *butyric acid* are due to entirely different ferments. The ferment of the first is a germ that lives in contact with free oxygen, and which causes the fermentation of milk in which we then find a sour taste, and the ferment of *butyric acid* is a germ which lives without free oxygen and gives to butter a rancid taste which is well known. This ferment is a vibrio of the order of the germs of putrefaction, and grows and develops better in a body or mass not penetrated by free oxygen, like butter.

Now, why butter made of sweet cream becomes rancid quicker than that made of cream which has stood for sometime, is probably due to the fact that in the latter the germs of lactic acid have developed and formed the lactic acid which perhaps destroys the activity of the butyric ferments, whilst in the former the the butyric ferments are churned in the sweet cream and gain access to butter in which they find suitable food for their growth. It is said somewhere by good authorities, I think, that the germs which can live in contact with free oxygen only, like the lactic acid ferment, cause the destruction of those which develop only where there is no free oxygen, like the germ of butyric acid. This also would assist in explaining the cause of putrefaction of butter made from sweet cream. In a word, I assert, and think I can prove, that if butter does not contain the germs of butyric acid, it will not take the rancid taste of this acid; hence, researches might lead to the discovery of some preventives for that butter disease and teach

the people how to make butter from sweet cream that keeps as long as from sour cream. This would be a step in advance, for it would give us a butter so sweet, with such a flavor, that no oleomargarine could ever compete with it, as it does now in many cases.

Col. Curtis replied to Dr. Paquin, and said he had never looked at the disease of butter in that light, and felt their was something worthy of attention in the hypothesis.

MEETING OF THE BOARD AT ELDON.

A Farmer's Institute was held at Eldon, Miller county, January 25–26, 1887.

Dr. Paul Paquin occupied the floor during the morning answering questions and giving causes and preventions of common diseases.

AFTERNOON SESSION.

Professor L. R. Taft gave his usual talk on Fruit Growing, after which the following questions were answered :

Q. Which is the best family strawberry ?

A. Cumberland Triumph.

Q. Would you check the growth of peach trees in the fall by stripping of the leaves ?

A. No, the bud is pulled off with the leaf and will injure the tree.

An Auditor: The ladies desire to know a cure for the cabbage worm.

Professor T.: Pyrethrum powder dusted over the cabbage will kill them.

Q. How will mulching do to check the growth of trees ?

A. I prefer a grass sod. Mulches harbor enemies, and as a rule need removing in August to allow the trees to ripen. Yet this can be done and put back in winter.

Q. At what time would you wrap trees to keep borers out ?

A. Early in the spring.

Q. How long will strawberries last without being moved ?

A. Some growers move them each year, others on rich soil keep them three or four years. I mulch in the fall and after the crop has

been gathered plow out close to the row, harrow down the ridge and cut out the weeds, leaving the plants a foot apart.

Mr. Shepherd: This is done in Illinois.

Q. Would you mulch newly set trees?

A. Yes, unless you till often.

Secretary Sanborn followed Prof. Taft with a talk on the social and intellectual life of the farmers and spoke of the aid that modern growth of science arts which have grown out of them have given to the farmer in these directions.

An adjournment was then taken until 7 P. M.

EVENING SESSION.

Secretary Sanborn was the first speaker and gave a talk on "How to Farm Profitably."

This was followed by a short lecture on Flowers by Prof. Taft for the ladies.

WEDNESDAY MORNING'S SESSION.

This meeting was unique. A good proportion of young men and ladies were constantly with us. This was due to the good influence of a farmers' club.

Everywhere that the Board finds active farmers' organizations there it finds a more intelligent interest in agricultural progress and greater social ease of character. Much interest was manifested in agricultural education. Several young men stated that it was their intention to attend the Agricultural College next year.

Prof. Taft was the first speaker, who spoke on the cultivation of grapes and vegetables.

Q. How do you make a hot-bed?

A. As usually constructed, they are six feet wide and of any length desired.

Mr, Sanborn followed, and by request gave plans on the blackboard of a convenient household with conveniences in the working de-

partments. Also the growth of potatoes and management of grass lands were discussed at some length.

The speaker insisted that the woman's department on the farm was the most neglected part of farm life in so far as household conveniences were involved; whereas the first money used for conveniences should go to the wife's aid.

MEETING OF THE BOARD AT JEFFERSON CITY.

An Institute meeting was held at Jefferson City, Cole county, January 26th and 27th, 1887.

AFTERNOON SESSION.

The Secretary was away attending a farmers' meeting at Eldon and Dr. Paquin gave an address on animal diseases, at the conclusion of which a lively discussion took place.

Adjourned until 7 P. M.

EVENING SESSION

Was occupied by Prof. Sanborn, who gave a lecture, illustrated by magic lantern projections, on plows, and concluded with a talk on the principles of plowing and how to plow. An interesting discussion followed.

AFTERNOON SESSION OF SECOND DAY.*

A part of the proceedings of this session was taken from the Jefferson City *Daily Tribune*, which part appears in quotation:

"The afternoon session of the Farmers' Institute called out some fifty farmers and legislators. The principal address was by President Laws, of the State University, on 'Agricultural Education.' After tracing his early history and identifying himself with the industrial

classes, he explained the origin and work of the Agricultural and Mechanical College. Previous to its foundation there had been no connecting link between the public school system and the university, the masses being unable to obtain an education which could be used by them in everyday life. To furnish such an education, the Agricultural College was founded. The endowment fund of the Agricultural College comes from the sale of land given the State by the General Government. It now amounts to $300,000, and certificates to the sum of $297,000 are now in the State treasury, made out in the name of the Agricultural College. The university fund of $122,000 was also derived from the National Government, and is represented by a certificate of that amount.

"In addition, the University has also another certificate of $100,000, which came from the State of Missouri. This was a part of an appropriation of about $200,000, of which $35,000 was given to the Mining School, $45,000 for the erection of the scientific building, for the use of the Agricultural college and for an agricultural library; about $20,000 to pay an old debt of the University, the balance of $100,000 to be an addition to the University fund, to reimburse the loss on stock held in the old State bank. It has been claimed that this should be accredited to the Agricultural College fund, but the original act and the certificate itself specifies that it is to be a part of the seminary fund. The State has thus given $40,000 to the Agricultural College, for which it deserves credit. The certificates specify that the income from the Agricultural College fund shall be expended as the law directs. In reality, however, there is no law on the statute book which specifies the use to which this money shall be put, and the Board of Control claim that as the college is by law a department of the University, that its income can be merged with that of the seminary fund, and that no separate account need be kept. They certainly have the right to do this as the law stands, but in order to show the use to which the money is put, a separate account of the two funds should be kept.

"In relation to the change of name on the catalogue, the speaker denied that it had been done surreptitiously, as it had passed through the hands of the board before reaching the printer. No power except the Legislature can change the name of the University, and the name on the catalogue was intended as a simpler title than the corporate name of the 'Board of Curators of the University of the State of Missouri.'

"It had been claimed that the University had swallowed up the College. The name Agricultural College and University merely showed that the college still existed, and as in business firms, it was only fair

that the partner with the largest income should appear first in the name.

"After reciting the work of the College as an educational factor in teaching 'such branches of learning as will promote the liberal education of the industrial classes, the science and classics not excluded, the speaker suggested that in view of the change of ideas during the last twenty-five years that a reconstruction of the work, name and method of keeping the accounts seemed necessary.

"Mr. A. Leonard, member of the board from Saline county, contrasted the farming methods of the west with those practiced on the rocky hills of New England, and attributed the ability of the latter to hold their own under unfavorable conditions, to their thrift and economy as compared with the neglect and waste of the average western farmer. The value of the crops wasted in Missouri exceeded the amount received from the portion sold, and this could only be corrected by a radical change in their system of farming and the use of more brains in directing these operations.

"Prof. Sanborn called on Major Warner, a member of the House, who gave his experience in dairying. By use of Jersey cows, a Cooley creamer, and proper care and attention, he found a ready sale for his butter at 30 and 35 cents, and derived a gross income of $75 per year from each of his dairy cows."

Q. What does the Cooley creamer cost?

Maj. Warner.—One with six cans will be enough for twenty-five cows. This will cost $48 in St. Louis, but in Chicago I got a discount, and it cost me $28.

He then explained their make.

The conveniences are needed, such as butter workers, good churns, pounders, paddles, butter boxes, ice, etc.

I believe I have a well equipped dairy, at any rate my neighbors come to see it as a model. Yet this pays, for I get 20 per cent. more butter and of good quality.

My creamer gives me no trouble in winter; when closed the warmth of the milk keeps the temperature up, and very seldom does the water freeze.

Q. How much is a cow worth that will produce 300 pounds of butter per year.

A. Three hundred dollars; but we can not get it, because our people are not educated up to the proper appreciation of good cows. I charge $5 for the service of a bull, and few used him. One gentleman did, however, and sold the calf for $25.

Q. Can we use water in the Cooley creamer?

A. Only when the water is cold and running. Ice is the best.

Q. How do you market your butter?

A. In earthen vessels, and have them returned.

Auditor. I churned 18 pounds of butter this week from 5 gallons of cream.

Q. What churn do you use?

A. The "Boss." I believe it is the best.

Mr. ——. I use the Blanchard churn.

Major Warner. The trouble is we don't get cream right for any churn.

Q. At what temperature would you churn?

A. It varies with the climate and cream. In winter I churn at from 65 to 66 degrees, Fahrenheit; in summer at 60 degrees. I do the milking and churning, and I believe that women should have little of the hard work to do.

Q. Do you sell on contract?

A. Yes; although my presence here two years has broken my contract.

Hon. John Walker followed, and stated that the farms of the State represented about half of the taxable property, and that some of the income might well be used to further the agricultural interests. The subject of stock feeding needs especial attention, and an appropriation of $15,000 or $20,000 will provide such accommodations at the Agricultural College as will enable Prof. Sanborn to test the effect of different food combinations on the various breeds of cattle, sheep and hogs. The results can be published and will be of incalculable value to the farmers of the State.

His remarks were made so rapidly that an intelligent abridgement could not be gotten.

The meeting was then closed by the Secretary, who said: This closes the eighteenth institute of the series for the winter of 1886 and 1887. Four years ago the first one was held that the Board carried forward to success. At that time the Board was practically without funds and mainly unknown to the general public. At that time it named its point of meeting and got a small attendance. Now the most intelligent portion of the community attend, and the Board is unable to fill the calls made upon it.

The Board has expanded from the issue of annual reports to a fuller work, including its crop report system, aided by 1,026 farmers, nine in each county, its farmers' institute meetings, and a large general correspondence.

During the coming year several important premiums will be given,

and if the General Assembly adopt, as they seem likely to, the proposed legislation recommended by the Board, a complete official knowledge of the resources of the various counties will be at our command, and other advances will be made.

In the meanwhile, the General Assembly has increased the annual appropriations from $1,250 to $2,500, and now print at the State's expense. They are now contemplating a large appropriation to the Board, so that the future usefulness of it is likely to increase.

BUTTER MAKING.

The following address was delivered by Col. F. D. Curtis, of Chicago, and formerly of New York, at Edina, Knox county, and La Plata, Macon county, Missouri. Col. Curtis will be recognized by those acquainted with dairy literature, as one of the countries ablest authorities on this subject:

The first consideration is a farm adapted to dairying, and the second is good dairy stock. Many a failure has resulted from not having dairy cows that would yield a profit. There is a wide difference between a herd of cows that yield on an average 100 to 150 pounds of butter each per annum, and one that averages per cow 250 to 300 pounds per annum. But one who grows beef may make something in the dairy line in addition to beef, but he is a beef-grower and not a dairyman, while dependence on dairying alone with such a herd would entail a failure. Where the two are combined, one or the other should be the leading object, and everything should be made to contribute to the end in view, be it beef or dairy products. So it stands one in hand to know whether he is a beef-grower or a dairyman, and govern himself accordingly.

But whoever starts into dairying must begin with the dairy stock which he already has, or he can pick up. This is not likely to be the best, and there is no way of at once improving the dairy stock of the country. Such as it is, it must remain until improvement can be reached through proper care, selection and breeding. It is not possible for all to have blooded stock, as there is not enough of this in the country; but all can have improved blood. Besides, it is expensive and unprofitable to buy pure-bred stock for mere dairying alone. Grades answer the purpose quite as well. They are cheaper and all can have them in a few years. The most feasible way of obtaining an improved dairy herd is to buy a male of the breed preferred, and be sure that he has, not only individual merit, but has a long pedigree showing he is descended from a milking family. Never use a grade, as you can never tell on which side he is most prepotent. The prog-

eny is pretty sure to be of the mongrel sort. Besides, when you breed from a grade, you breed down instead of breeding up. With a pure-blood you are always breeding up; and so long as your bull is superior to your breed of cows, you are on the road to improvement. Great care should be taken that the male is at least as good as the cows.

Breed your pure-blood bull to your best cows, and raise the female offsprings. Test these, and retain only the best. Breed again from these, and repeat the testing and selecting. Continue this process and in a few years, if you have made a judicious selection of males, you can have a herd of grade cows for dairying that will be as good and perhaps better for all practical purposes than a full-blood one. In time the herd will be of such high grade that they will begin to rank as pure bloods. In this way a yield per cow of 250 to 300 pounds of butter, or a corresponding amount of cheese, will be secured. By thus improving herds the quality of the dairy stock of the entire country will be raised.

The male is more than half of the herd, in determining its character. Like begets like. As the seed planted determines the character of the crop, so the male used determines the type of the offspring. The better the soil and the more favorable the conditions, the better the crop; so the better the cows and the more favorable their surroundings, the better the offspring.

Much can be done by proper feeding and care; but no amount of feed and care will make a profitable cow out of an unprofitable one. It may increase the receipts from her. But a good cow just as quickly responds to good feed and favorable environments, and, indeed, gives a better return for extra feed and care. These are essentials for keeping up the quality of the herd, as well as for its improvement. There is no magic by which a cow can produce something from nothing. Whatever of beef or milk she produces must come from the food she eats, the water she drinks and the air she breathes. The best cow is the one that can consume the most of these and convert the largest proportion of them into dairy products. The quality, as well as the quantity, is affected by the food. This is shown in the well known fact that leeks, cabbage, onions and other rank foods impart their flavor to the milk. So the water drank has its effect on the milk. A few years ago, at Cornell University, a case occurred where the milk of a herd suddenly became bad. Investigation showed that it resulted from the cows drinking stagnant water. The germs of microscopic growths that had sprung up in the water were found in the blood of the cows, whence it was filtered into the milk secretions and made them unwholesome. It is, therefore, essential that cows have clean, sweet

water to drink, and where they can get at it without going too far. If it is at a remote point, they will get very thirsty before going to it, and then they will gorge themselves, to their injury and that of the milk product. In winter they should not be permitted to get chilled when going out to drink, and even ice-cold water is injurious. Many dairymen are finding that it pays to keep their cows in the stable on all but fair, warm days, and to give them tepid water to drink. It pays to keep up the temperature of the stable to 45 degrees or above, but not above 60 degrees, by artificial heating. So the air which the cow breathes must be pure and sweet. Inhaling wind that comes over an onion field, or is loaded with the odor of carrion, has been found to taint the milk product; and Prof. Arnold, the best dairy authority that we have, says that fifteen minutes in a foul, unventilated stable, breathing the impure air, will impart a smell and taste of the barnyard to the milk of cows.

Cleanliness is, therefore, a very important consideration about the dairy. The milking must be done in a clean atmosphere, in a cleanly manner, and into well-cleaned pails. Do not depend on the strainer to take out dirt. Keep the dirt out of the milk. If you do not, the soluble portions of it will remain to taint the milk and its products. If the stable or other place of milking is foul, the air will be filled with bacteria and other microscopic germs that will fall into the milk, sprout and grow there and injure the butter or cheese made from it. Many a dairyman has had, to him unaccountably, bad luck arising from this source of taint and trouble. All milk utensils, and whatever comes in contact with the milk, should be thoroughly washed in warm water, with soda or other alkali to cut the grease, then scalded in boiling water. It is an improvement to expose them to the air and light, as these are great purifiers in their natural condition. Set the pails and other utensils tipping a little downward, so that dust and the microbes that may be in the air will not fall into them.

Milk for butter-making should be strained and set as soon as possible after milking and before the temperature falls much. The warmer it is the better. In cold weather, if the temperature is much lowered, it should be raised by artificial means to about blood heat before setting the milk. The reason for this is that cream rises best when the temperature is falling, and the farther it has to fall the more complete the separation. If cooled suddenly the more rapid the separation. Hence all the advantage of cold setting, save that it keeps the milk sweet longer. In all cases of deep setting there must be rapid cooling, or the milk will sour before the cream is up. In shallow setting in cold air, care should be taken to keep the atmos-

phere pure. The same in open cold setting is also essential. So long as the air is colder than the milk, there is an exhalation from the latter which the air absorbs; but as soon as the milk gets colder than the air, the action is reversed and the milk absorbs moisture from the air, with all that the air may contain.

The milk should be skimmed as soon as it begins to show acid, or a little before. Every time a new batch of cream is added to the contents of the cream can, it should be well stirred up and evenly incorporated with the mass. Occasional stirring between skimmings is an advantage. Make no additions to the batch for twelve hours before churning, unless you want to waste the last addition and make rich buttermilk. Keep the cream at a temperature of 55 degrees or below, but not necessarily below 50 degrees. Many think that a lower temperature injures the keeping quality of the butter by chilling the fat globules, which are affected as meat is when put in ice, or butter is when kept in cold storage, the flavor rapidly deteriorating as soon as exposed to a higher temperature.

The rule of the best butter makers is to slowly raise the temperature of the cream to 60 degrees, or whatever is the churning point, and then churn as soon as it is distinctly acid, and before it gets very sour. As soon as the sugar in the milk is turned into lactic acid, and before the fermentation begins to generate alcohol and vinegar, the churning should begin. If the acid is carried further, there is a loss of both flavor and product. The weight may be kept up by the retention of more caseous matter, but it is at the expense of the quality of the butter.

As soon as the butter appears in granules of the size of birdshot, stop the churn and rinse the sides by using water at a temperature of 55 degrees or below, to 48 degrees. This will reduce the temperature and make the granules so solid that they will remain separate in the future handling. Then draw off the buttermilk and rinse the granulated butter with the cold water until it runs clear, but do not "gather" the butter. If the last washing is in brine, it facilitates the separation of the caseous matter from the butter. Some throw a little salt into the churn before drawing off the buttermilk, as it not only hastens the separation of the fat from the milk but hardens the granules of butter. It also salts the buttermilk, which may be an objection.

There are different ways of applying salt. Some drain off the water until just enough is left to dissolve the required amount of salt, and then stir it in. Some salt with a saturated brine. If this is done, the last washing should be in brine, or a little salt should be added to saturate the water already in the butter. Some take the bull by the horns, and at once throw in salt enough to saturate the water in the

butter and a given amount of additional water, which is converted into brine. This brine is drawn off and used several times, each time a proportionate amount of salt being added to keep up the whole to the point of saturation. The butter is allowed to remain in this pickle an hour or so, when it is either put directly into the package, and the surplus brine poured off and saved, or taken out and pressed together on a worker and then packed. This latter method requires more salt, but is claimed to have its compensating advantages in the saving of labor and securing absolutely even salting. The salt should be the finest that can be had, and of fine, even grain, and easily dissolved. The cost is but trifling—not over 5 cents for a 50-pound tub of butter, when the very best English salt is used. So it does not pay to take any risks with the cheaper salts, which are unreliable, and may cause a loss many times greater than the bagatelle of a saving in the purchase.

The package should be such as the market calls for. If wood is used, it should be thoroughly soaked, to get out the woody flavor, and then saturated with brine by thoroughly soaking.

CHEESE MAKING.

The handling of milk for cheese is quite different from handling it for butter. Cheese requires the same cleanliness from first to last, but the milk cannot be cooled too soon down to a temperature of 60 or 70 degrees after being drawn from the cows. It needs to be agitated to keep the cream from rising. If carried to a factory, the night's and morning's milk should be delivered in separate cans, as it has been found that milk changes very rapidly after the hot and cold milk have been mixed. In carrying to the factory, the cans should be ventilated and protected from the rays of the sun. The can should be rinsed in cold water as soon as the milk is poured out. Then, as soon as possible, after returning home, the can should be washed in warm water to which a little sal-soda, borax, and other alkali is added, and afterward scalded with boiling water and turned down on one edge to air and sun until needed for use.

The milk delivered at the factory, the responsibility of the cheese maker begins. If he has good milk, he should be held accountable for the results, provided, the facilities for manufacturing and curing (especially the latter) are what they should be. If the milk is full of the germs of ferment and decay, woe be to him. How easily these may creep in was strikingly illustrated by an incident at the New York Agricultural experiment station, a year or two since. Suddenly the milk became bad, showing the presence of Casteria. The cause was traced to a small remnant of glucose meal that was fermenting in the corner

of the building, some distance away from the cows. The removal of the meal cured the trouble. How many ordinary dairymen would ever have investigated and found out the cause of their bad milk—provided they knew the milk was bad? The chances are that the cheese maker would have had witches in the vat, or in the curing room, and nobody would have known the cause.

When the milk is in the vat, the first thing is to slowly raise the temperature to eighty-two degrees in summer, or eighty-six in spring and fall, and then add the coloring and rennet. The milk should be gently stirred, while the temperature is rising, to keep the cream from separating. It is better to use prepared rennet, as it is more uniform, is not so likely to be tainted, and saves work. Where rennet is prepared at the factory, it is very generally tainted stuff, unfit for any kind of human use. Proportion the amount of rennet used to the time the cheese is expected to keep. If for immediate market and consumption, when ten days old put in rennet enough to cause the beginning of coagulation in five to ten minutes; for ordinary keeping, coagulation should begin in fifteen to twenty minutes; and for long keeping, in twenty-five to forty minutes. The maker must know by experience how much to use. Cut the curd as soon as it will make a clean break across the finger when inserted and lifted gently upward. Cut early, while the curd is tender and will part easily before the knife-blade. There is more danger of cutting too late than too soon. The cutting is to facilitate the separation of the whey from the curd. Hence, cut early and when cutting begins, continue it expeditiously until it is completed. Cut until the pieces will average about the size of kernels of corn. Then begin to raise the temperature at the rate of about one degree in five minutes, until it reaches ninety-eight degrees, or blood heat. All the while the temperature is rising stir the batch gently with a rake, to keep the curd from packing on the sides and bottom of the vat, and equalize the temperature throughout. A hay-rake with a piece of the handle, and one tooth with each end of the head cut off, is as good as anything. After the heat is up, only occasional stirring is necessary. Keep up the heat until the curd is what is called "cooked" or when a handful of it squeezed gently into a ball with a pressure equal to that ordinarily given in milking, will readily rattle apart when the hand is opened. This point must be learned by actual practice. Then draw down the whey until just enough is left to freely float the curd. Stir occasionally, and be sure to draw off the balance of the whey as soon as any acidity appears. It is better to draw sooner than to allow any positive souring. With proper managing, the whey may be drawn quite early, but the average cheese maker does not seem to get along so well as he does when he draws the whey

as it is just on the verge of souring. At this point, no injury is done to the curd. If it goes farther, the acid cuts the phosphates and finer oils, and impoverishment begins. If carried far enough, the butter may be nearly all consumed, the phosphates nearly all dissolved and washed out, and the result be a poor, dry, hard cheese, unfit for human food. By the old acid process, the acid was carried far enough to make the cheese soggy, sour and indigestible. But draw the whey sweet, and all this evil is avoided. All the whey, but what will remain is out of the curd, carrying with it fully two-thirds of the sugar. This will turn to acid and dissolve the phosphates; but as none of the whey runs out, none of the phosphates are washed out, but remain to revert to their original condition when the acid fermentation is over. With the whey drawn off, there is no danger of too much acid, let the curd stand as long as it will. There will be just so much acid and no more. This should be developed before the curd is put to press. The whey out of the curd, and the curd out of the whey, before the acid appears, the point of danger is past. We can take our time, and must take time, if we get the best results.

There are different ways of managing after the whey is drawn. One is to cover the vat, to keep up the temperature after having drawn the curd from one end of it, piled the curd along the sides and tipped up the end of the vat opposite the one from which the curd is drawn. This lets the whey run off, and leaves a place to receive it. With occasional cutting with a dull-pointed knife and turning the curd to keep the temperature even, it may stand for hours. It should stand until the curd will spin threads at least an inch long when tried on the hot iron. Then grind it, salt it and put it to press. This is the American cheddar process, and it probably the best one.

But most cheese factories in the West are small, and have no curd mill. They must salt in the vat. This involves a good deal of hard work in stirring the curd, to keep it from packing, when the whey is drawn sweet. To obviate some of this difficulty, the temperature may be lowered to 92 degrees before drawing the whey, then as soon as the whey is well drawn off, add the salt, and pile up the curd along the sides of the vat, or at one end, with the vat tipped up, as before indicated. In this way the curd will not pack so badly that it cannot be readily broken apart with the hands. Keep the temperature above 90 degrees until the acid shows threads on the hot iron at least an inch long, then cool to 80 degrees and put to press. There need be no hurry about it, however. No harm will come to the curd. By this method a little more time is probably required, as the lower temperature retards the fermentive and cheesing process, and some think the salt also retards chemical action. As a rule, time enough is not taken, and

the curd is frequently put to press—that is, before the sugar has all turned to lactic acid. When put to press too soon the cheese swells and appears soft and inclined to get out of shape. Retaining all the butter and phosphates makes a softer cheese than is made when a portion of them are dissolved and run out. This may require a little more cooking and longer holding before the curd is put to press. But this is the only way by which the richest, most buttery, most palatable and most digestible and nutritious cheese can be made and it can be made firm enough for all marketing purposes, and even for shipping, while it is the kind that the Englishman as well as the American likes best. If we make such cheese, we shall consume more at home and ship less, with better prices.

But the best cheese cannot be made without a suitable curing-room. This is one of the most essential things connected with the industry. The curing-room must be so constructed that the temperature can be controlled at all seasons of the year, at 65 to 70 degrees. If it is irregular and goes much above this, it will injure the product. Poor curing-rooms, in which the temperature goes up and down with that outside, and for days ranges through the eighties, have cost the dairymen of this country many millions of dollars. This kind of curing-room is the prevailing one in this country, and especially in the Northwest and West. Better curing-rooms are a much-needed reform in the cheese industry.

DAIRYING FOR PROFIT.

An address delivered by Hon. I. B. Warner, of Sappington, St. Louis County, Missouri, at a Farmers' meeting held in Jefferson City, Mo.

I will give you, in my rambling way, my experience in butter-making, management of a small dairy, and how to make farm life one of content and profit to the old and middle-aged man, as well as the young man and farm boy. After all is done and said, whatever position we hold on this little earth of ours, whether as farmer, merchant, clerk or common day laborer, we cannot succeed unless we are honest, frugal and industrious. In 1873 I quit the service of the United States Express Company, in St. Louis, and came to this place, eleven miles from the city; commenced farming in a small way on 28 acres of land; set out grapes, raspberries and other small fruits; but in four or five years I saw that marketing by day and by night was as irksome as running messenger four nights out of seven on the railroad for the express company. So I made up my mind, after looking over the matter thoroughly, that I could make more clear money from my little farm, with less work, by making butter. In 1874 I bought a three-fourths Jersey cow, and at present I have 28 nice heifers and cows, and have sold 105 head of male calves that sprung from the cow I bought in 1874, and I have the old cow now on hand, she being as lively, apparently, as when 10 years of age. When beginning to make butter I was told by my neighbors that I could not make butter-making profitable here in this warm climate as at my old home in Vermont, but I felt that I was on the right track, and so far, I know I have made and am making more money with less hard work than any other business connected with farming. I, of course, soon saw that, in order to be successful, it was important that I should have all the modern appliances for butter-making. After getting eight or ten cows under way I saw it was all-important to have, above everything else, a good, warm stable; so I

built an underground barn 80 by 24 feet, with a loft above with ample room for 25 tons of hay. I also saw that to get the best results it was best for my cows to become fresh the last of August or first of September; then my fat calves would be out of the way by October, when the weather was becoming cooler and the price of butter higher. While it is no great trick to make reasonably good butter in cool weather, from say October 1 to April 1, it is a trick for most butter-makers to make it during the warm months. At times, until the last two years, I felt a little discouraged at not getting a full price for my summer butter—say 30 cents and up. But two years ago I bought a Cooley creamer, six cans, a barrel churn called the Boss, manufactured at Rockford, Ill., by H. H. Palmer & Co., and the Lever butter-worker, all these articles costing me $42. Added to this my stable, costing $350, you will see a man can fit himself for butter-making for $392. Since buying the creamer I find I am making a much better article of butter at far less cost; am making 20 per cent. more in warm weather and 10 per cent. more in cool weather than by the old way of setting milk in crocks and tin pans; am able now to get as good a price at the grocer as he pays for the best Elgin creamery. The creamer uses from 60 to 80 pounds of ice each day, and certainly the butter keeps far better than made in the old way. I look upon Higgins' Eureka salt as the best for salting butter; use one and one-half ounces to each pound of butter. Perry's butter color is the best for winter coloring. Cleanliness, regularity in milking and kindness to your cows are truly requisite. Milk should not be allowed to remain in the stable after drawing from the cow, even for a minute, when it can be avoided, and the quicker it is put into the creamer and cooled, the better. Good results can be reached by churning at least three times a week. Cream, as all should know, goes into the second acid stage, if allowed to sit around too long. By having the creamer I need no milk house, leaving it out on a north porch winter and summer. What is the best feed for butter cows, is a question often asked. I have tried all kinds, and I have the best results in winter from pure water, well preserved first crop clover, six quarts of bran and one quart of good corn meal, made into a hot mush twice a day, and warm, clean, well ventilated stable. For summer feed good blue grass and orchard grass I look upon as the best; added to this, drill a few acres of good sweet corn or Sanford corn, putting in a half acre or so at a time, so as feed it green when the pasture gets short and dry. I drill in rows just wide enough to allow a horse to cultivate; by cultivating it will not lodge before using, and should you not want to feed all of it you can cut and shock it at the proper time and feed in fall before

beginning to stable and have your good clover to feed under cover. Most farmers know that it costs as much to keep a poor cow as a good one, and that it costs as much to make a poor pound of butter as a good one.

Now, some may say: "Well, it's all right for a man to talk about butter-making who lives near a large city, where he can always get a good price for butter." Any one who will use a Cooley creamer can make good butter and can safely count on 25 to 30 cents per pound the year through, and it will not cost over one cent per pound to ship by express. Some weeks ago a lady living in Chicago visited friends in St. Louis, and when here used some of my butter, made from the Cooley creamer. Last week she wrote me to send her a nine-pound package, saying that she could get no butter there that she thought as good as mine. I only mention this as a proof that good gilt-edged butter can be made in Missouri as well as in Vermont or Wisconsin. Should the oleomargarine law be enforced properly, I believe the demand for good country butter will be greater than ever before.

The question has often been asked me how old should a Jersey cow be when with her first calf. As all know, they breed very young, some when only nine months old, but I am confident they make a better cow if they do not become fresh before they are twenty-four or thirty months old. I have one that was only twelve months old when she calved, and she makes four or five pounds of butter every week. I have several cows in my herd that make from ten to fourteen pounds a week when they are fresh. I believe, were I to feed them high, they would make from twelve to eighteen pounds a week. My herd will average me (twenty-four head) from $1,700 to $2,200 a year. I look upon a cow as No. 1 that produces 230 pounds of butter forty-six weeks every year. Each cow will, in addition to raising her calf, raise one shoat up to fattening time, say nothing of manure. I am confident butter-making pays better in the long run than anything connected with a farm. Many farmers say, "Oh, well, I would keep cows for profit, but it's too hard on the women folks." Butter-making and milking is not woman's work; it's man's work, all of it.

PARASITIC FUNGI OF MISSOURI.

B. T. GALLOWAY.

During the year 1886, Prof. S. M. Tracy and myself collected in this State about three hundred species of fungi. Of this number, fourteen are new species. Mr. J. B. Ellis, of Newfield, N. J., has aided in the determination of many species. Mr. Ellis has also published descriptions of several of the new species in the *Journal of Mycology*. Excepting a collection made by Mr. C. H. Demetrio, of Perry county, this is the first systematic work of the kind undertaken in this State.

Mr. Demetrio has collected several hundred species, many of which are new.

(A list of Perry county fungi appeared in Hedwigia, 1885, Heft V. Beitræge zur Pilzflora von Missouri. Von Dr. G. Winter and C. H. Demetrio.)

We have collected about 2,500 specimens for distribution in Ellis' North American fungi.

Specimens of all the species collected have been placed in the University Herbarium.

The parasites commonly known as mildews (Erysiphei) have received special attention, and I believe that this is the first attempt made in this State to determine the plants of this order.

In the specific descriptions we have followed Bessey's Erysiphei of the United States, and Cook's British fungi.

Thanks are due Mr. H. P. Dorsett for valuable assistance.

This list is not complete, but it is a beginning, and we hope to continue the work until all of the species are catalogued.

MILDEWS OF MISSOURI—ERYSIPHEI.

The parasites which attack the higher plants, causing the diseased condition commonly known as mildew are exceedingly common, and

easily studied. Most of the species belonging to this order are parasitic in habit, and obtain nourishment from the tissues of the higher plants. In fact the members of this order are robbers; they live and grow at the expense of the higher plants. Several species belonging to this order are quite destructive, as for example the rose mildew, *Spharotheca pannosa*. The plant body or vegetative portion of the members of this order consists of long, branching, cobweb like threads. The threads are extremely minute, but as they continue growing they cross and re-cross each other and ultimately cover the parts of the host attacked with a dirty white coating.

The threads (called hyphæ) grow entirely upon the surface of the host or supporting plant; and obtain nourishment from the host by means of *haustoria*, or suckers, which are formed on the side of the thread next to the epidermis of the host. The hyphæ or threads usually appear in early summer, and soon after they make their appearance the threads send up a number of vertical branches which are at first entire, but owing to the formation of transverse partitions the vertical threads soon become several celled. (Plate, Fig. 7.)

Thus we have formed a number of globular bodies, arranged like beads on a string. The slightest touch destroys the chain-like arrangement and the globular bodies are set free. The globular bodies are known as *conidia*, or summer spores, and whenever the proper conditions of moisture and temperature are present the conidia germinate and give rise to the same kind of threads from which they were derived. This production and germination of conidia continues through the summer months, till ultimately the parts of the plant attacked are completely covered with a dirty white coat. Late in the fall the cobweb like threads give rise to another kind of reproductive body.

This body is larger than a conidium and is colored black or dark brown. The dark colored globular bodies are known as perithecia. The surface of the perithecium is finely recticulated, (Plate, Figs. 1 to 6), and springing from the surface are a number of delicate threads or appendages which are usually colorless, and more or less variable in size and shape. Each perithecium contains from one to many transparent sacs, or asci; and within each ascus is contained the spores or reproductive bodies. At figure I is shown a ruptured perithecium of the common rose mildew *Sphærotheca paunosa*. In this species the perithecium contains but one ascus, (a) and within the ascus is shown a number of spores. (b) As stated above the perithecia are usually formed late in the autumn, and they fall to the ground with the leaf and live through the winter. The thick wall of the perithecium pro-

tects the spores until the growing season arrives when the perithecia burst and the contained asci and spores are set free.

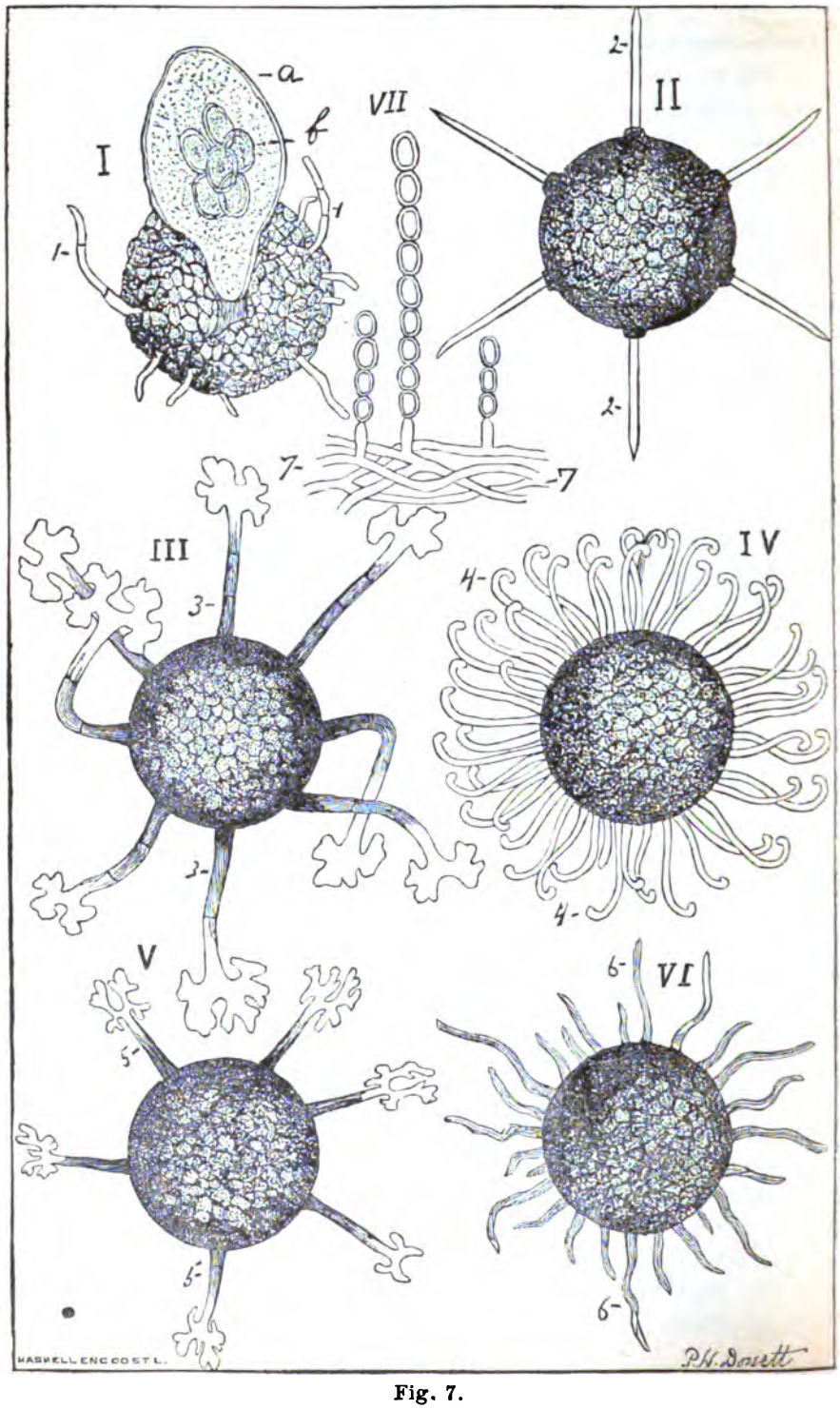
The spores are exceedingly minute, ten millions of them would not cover a square inch. The spores are carried about by the wind and when they fall upon the proper host plant they germinate and give rise to the cobweb-like threads, which in turn give rise to the conidia. This completes the life history as far as made out. Frost destroys the conidia spores, but as I have already shown the perithecia which are formed late in the autumn live through the winter. Formerly nearly all the species of this order were included in one genus; but at present we have several well marked genera which are easily distinguished by the form of the appendages and the number of asci contained in the perithecium.

Below is a key to the genera.

I. Perithecia, containing a single ascus.
   1. Appendages floccose, genus Sphærotheca.
   2. Appendages dichotonnous genus Podosphæra.

II. Perithecia containing many asci.
   3. Appendages needle-shaped, rigid, genus Phyllactinia.
   4. Appendages hooked, genus Uncinula.
   5. Appendages dichotomous, genus Microsphæra.
   6. Appendages floccose, genus Erysiphe.

An examination of the figures will show the various forms of the appendages.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HASKELL ENG COST L.
P.H. Dorsett

Fig. 7.

Fig. I. A ruptured perithecium of Sphœrotheca pannosa Wall; 1-1 floccose appendages; (a) ascus; (b) spores.

Fig. II. Perithecium of Phyllactinia; appendages rigid, needle shaped; the perithecia of P. suffulta contain from 4 to 20 asci.

Fig. III. Perithecium of Podosphæra oxagantha, D. C.; 3, 3, appendages dichotomous or branched at the tips, ascus 1.

Fig. IV. Perithecium, of Uncinula adunca, Wall; 4-4, appendages hooked; asci, several.

Fig. V. Perithecium of Microsphæra; 5, 5, appendages, tips branched.

Fig. VI. Perithecium of Erysiphe Martii, (L. K;) 6, 6, floccose appendages.

Fig. I., afterTulasne; II. to VII. after Cooke.

In the following pages are described, first, the genus, followed by a description of the species belonging to that genus and notes on the injurious species that have come under my own observation. For example, the first genus described is Sphærotheca, followed by a description of three species with additional notes.

The measurements are in decimals of a millimeter, (m m); 1 m m = .03936 inches.

SPHÆROTHECA, Lev.

Mycelium arachnoid; (cobwebby); perithecia spherical or nearly so, containing a single ascus. (Berk.)

1. **Sphærotheca pannosa,** Wall. Mycelium brown, forming thick felted masses on the leaves and young branches of roses. The perithecia are minute, spherical or nearly so; .085 m m to .088 m m in diameter; appendages short, colorless. The perithecial fruit is usually found late in the fall. The conidial stage appears in early Summer, and the fungus is rapidly propagated during the Summer months by means of the conidia, which readily germinate whenever suitable conditions of moisture and temperature are present. This fungus is one of the worst enemies of the rose, especially the teas and other tender varieties. Sulphur is one of the best known remedies. It should be dusted on the affected parts, care being taken to first wet the leaves. We have noticed that this fungus rarely attacks plants that have been kept in a healthy condition. Weak plants are always the first attacked.

2. **Sphærotheca** Castagnei, Lev.

Mycelium abundant, web like, commonly persistent.

Perithecia very minute, globose, .08 to .10 mm. diameter; appendages usually exceeding the the diameter of the perithecia; flexuose. Ascus with usually 6 to 8 spores.

Common on both sides of the leaves of *Taraxacum dens leonisc Vernonia sp*, *Bidens frondosa.*

The mycelium often occurs in patches, perithecia usually abundant.

3. **Sphærotheca** Mors Uvae, (Schwein), Berk.

Bessey does not describe this species. Our specimens were collected in Perry county, by C. H. Demetrio, and give the follow characters:

Mycelium dense, forming thick felted masses; brown; perithecia brown or almost black, .08 to .11 mm. in diameter, reticulations not prominent. Appendages few, short, colored, usually flexuose above; ascus sub-pyriform, many spored; spores light yellow .020 by .025 (m m.)

On the fruit of wild gooseberry, September; not common.

PODOSPHÆRA, Kunze.

Mycelium effuse, web like; perithecia spherical, containing one sub-globose eight spored ascus; spores ovate; appendages few, dichotomous, thickened at their extremities, hyaline, (Cook).

4. **Podosphæra** oxagantha, D. C. (P. Kuenzi, Lev. P. tridactyla Wall.)

Mostly amphigenous; fruiting on both sides of the leaf; perithecia dark brown, .08 to .11 (m m.) in diameter, reticulations prominent. Appendages variable, from five to twenty, colored for more than half their length, three to four times parted tips frequently swollen; ascus oval, thick walled; spores 8.

Common on leaves of cultivated plum and cherry, also on leaves of young apple trees. This species also occurs on *Amelanchier canadensis*, (Shadbush) *Spiræa tomentosa* and *Cratægus* sp.

Earle has made a special study of this genus, and below is his description of the forms that occur on Amelanchier and Spiræa.

Form on Amelanchier.

Amphigenous, or epiphyllous; perithecia .09 to .11 m m. in

diameter; appendages eight to sixteen, in length two to three times the diameter of the perithecia; tips swollen.

Form on Spiræa.

Amphigenous, fruiting both sides of the leaf, or more abundantly above; perithecia small, .09 to .11 mm. in diameter; appendages numerous, 12 to 24, radiating from all parts of the upper surface, 1 to 2 times the diameter, 3 to 5 times parted, tips only slightly swollen.

We have specimens which correspond very well with the description given by Earle.

P. oxagantha is one of our most common species. It occurs abundantly on the leaves of young apple trees, frequently causing the affected parts to become twisted and distorted. When this fungus attacks plums and cherries it causes the leaves to fold lengthwise. The conidial stage usually appears on the cherry and plum about the last of August, and the perithecia occur during the months of September and October. The perithecial fruit rarely occurs on the apple, but is usually adundant on the leaves of cherries and plums.

The injury produced by this species is frequently considerable; as it checks the growth of the leaves and prevents the fruit from properly maturing.

PHYLLACTINIA, Lev.

Mycelium abundant; perithecium containing several asci, appendages needle shaped, rigid. (Cook.)

5. **Phyllactinia** suffulta, Reb., (P. guttata, Lev.)

Amphigenous; mycelium thin, web-like, perithecia dark brown, scattered; .11 to .13 mm. in diameter; appendages rigid, 7 to 9; colorless, about three times the length of the diameter of the perithecia; asci 4 to 16, or more, spores 2 to 4.

On the leaves of *Betula nigra* (Birch), and species of Cornus, August and September, common. (Berk.)

UNCINULA, Lev.

Mycelium flocose; perithecia globular, or nearly so; appendages simple or dichtomous, hooked. (Berk.)

6. **Uncinula** adunca, Wall. (W. Salicis, D. C.)

Mycelium thin; usually on under surface of leaf; perithecia globular, scattered, .08 to .10 mm. in diameter; appendages numerous, simple.

Asci eight to twelve; containing usually four spores.

This species is common in fall on various species of willow. (Salix). The perithecial fruit is formed during the month of September and October. C. H. Demetrio reports this species from Perry county.

7. **Uncinula** Americana, Howe. (U. Spriralis, B. & C.)

Mycelium web-like; usually on the upper surface of the leaf; perithecia brown, .08 to .12 mm. in diameter. Appendages 15 to 20, or more; 35 to 55 mm. long; bending gently in opposite directions; brownish at the base, transparent at the tip. Asci usually about 6, spores 6.

On leaves of cultivated grape; perithecial fruit is usually formed late in the fall. This fungus usually occurs on the upper surface of the leaf, and produces white powdery spots. The powdery spots consist of minute threads which are attached to the leaf by suckers. The threads usually appear about the first of August, and soon after making their appearance they send up a number of vertical branches, which are at first entire, but ultimately are divided by a number of transverse partitions. Thus we have formed a number of globular bodies (the conidia) which germinate whenever the proper conditions of moisture and temperature are present and give rise to the same kind of threads from which they were derived.

As stated above, the perithecial fruit is formed late in the fall, lives through the winter, and germinates the following summer. As the plant body of this fungus is superficial, it is quickly destroyed by sulphur, which may be applied as recommended for rose mildew.

8. **Uncinula** circinata, C. & P.

Mycelium dense, effuse, frequently persistent; perithecia large, .14 to .18 m m. in diameter; depressed or flattened; dark brown. Appendages numerous, slender, about as long as the diameter of the perithecia; simple, colorless. Asci, 16 to 22; spores, 8. On the lower surface of the leaves of silver maple, common.

This species usually appears late in the fall, and as far as we know, the injury it occasions is slight.

9. **Uncinula** flexnosa, Peck, in Tans. Albany Inst., Vol. VII., page 215. We have received specimens of this species from Mr. Peck, New York; also from Rev. C. H. Demetrio, Perryville, Missouri. Our specimens give the following characters.

Mycelium thin; perithecia scattered or gregarious; .07 to .12

m m. in diameter, brown, prominently reticulated; appendages, 20 to 50, or more, scarcely longer than the diameter of the perithecium, colorless, wavy, flexnose above. Asci, 5 to 7; spores, 7.

On leaves of *Æsculus glabra* (Horse Chestnut), August.

10. **Uncinula** parvula, C. & P.

Hypophyllous, mycelium usually covering nearly the whole surface; thin. Perithecia scattered, globular, or nearly so; dark brown, .08 to .12 mm. in diameter. Appendages, 20 to 30, or more, simple, usually from .08 to .11 mm. long; asci elliptical, bearing a beak or prolonged appendage; spores, 6.

On Hackberry leaves not common. Perithecial fruit may be found during the months of September and October.

MICROSPHÆRA, Lev.

Mycelium arachnoid, (web like); appendages straight; dichotomous (two-forked,) branchlets swelling at the tip, or long, slender and cylindrical. Perithecium containing many asci. (Berk.)

11. **Microsphæra** diffusa, C. & P.

Mycelium thin; scattered and web-like; perithecia black, globular, or nearly so; .07 to .09 mm. in diameter; appendages 20 to 30, once or twice as long as the diameter of the perithecium; colorless, irregularly divided and slightly nodulose at the tips.

Asci four to six, ovate; containing four to six spores. On the leaves of *Desmodium Canadense*, common; perithecial fruit occurs late in the fall. Demetrio reports this species from Perry county, (Beitrage zur Pilz-flora von Missouri.)

The mycelium occurs on both sides of the leaf, but it is usually more dense on the upper surface.

12. **Microsphæra** extensa, C. & P.

Mycelium thin, usually persistent, web like; perithecia globular, or nearly so; black, .07 to .09 mm. in diameter.

Appendages 8 to 12, three or four times as long as the diameter of the perithecia; 4 to 5 times dichotomously branched above; asci 4, ovate, spores, 4 to 8. On leaves of Quercus rubra. September and October, common.

On leaves of *Quercus imbricaria*, September. Demetrio, Perry county, Missouri.

This fungus usually covers the entire upper surface of the leaf with a dirty white coating.

13. **Microsphæra** abbreviata, Peck.

Mycelium thin; perithecia scattered or crowded; small. Appendages shorter than the diameter of the perithecium; transparent, 6 to 15 in number; tips dichotomous, the ultimate branchlets curved. Asci, 3 or 4; spores, 3 to 5, large; .09 to 12 mm. long. Under surface of oak leaves (Quercus rubra), October, Boone county, Missouri.

Differs from M. extensa in having the appendages shorter than the diameter of the perithecium; and is usually found on the under surface of the leaf.

14. **Microsphœra** Friesii, Lev.

Amphigenous; mycelium thin, persistent; perithecia dark brown, globular or nearly so; .09 to .11 mm in diameter; scattered or crowded; recticulations prominent. Appendages 6 to 12, not exceeding the diameter of the perithecia; asci 4 to 7, spores 6.

This species occurs abundantly on the leaves of the cultivated lilac, covering the leaves with a dirty white coating. The conidial stage appears about the first of August, and about a month later the perithecia may be found.

Although this is one of our most common species yet, the injury it occasions is of little consequence, owing no doubt to the fact that the fungus usually appears at a time when the leaves are of less use to the plant than earlier in the season.

15. **Microsphæra** euphorbiæ, B. & C. Mycelium thin; usually persistent; perithecia brown, small, globular or nearly so; appendages several times longer than the diameter of the perithecia; colored near the base; usually twice forked, branchlets lobed at the tips.

On leaves of *Euphorbia corollata*, October, Boone county, Mo., not common.

The mycelium of this species usually occurs on the upper surface of the leaf; it is also occasionally found in the lower surface.

16. **Microsphæra** Ravenelli, B.

Mycelium dense, sub-persistent, covering the upper surface of the leaves with a dirty white coating; perithecia small, globular or nearly so, .07 to .09 mm in diameter, dark brown; appendages 10 to 15, usually about 12; one and a third times as long as the diameter of the perithecia; colorless above, slightly colored below; tips 5 to 7 times forked. Asci 4 to 6, spores 6.

On the leaves of *Gleditschia tricanthos.* (Honey Locust.) August, common.

17. **Microsphæria** symphoricarpi, Howe.

Mycelium thin, sub persistent, perithecia minute, usually crowded; appendages 8 to 16, usually about 12, three times the length of the diameter of the perithecia, several times dichotomous at the tips; branchlets widely divergent; often truncate, asci 4 to 6, spores 3 to 5.

On the leaves of Buck bush, *Symphoricarpus vulgaris.*

The conidial stage of this species is quite common; the perithecial fruit however is rare.

18. **Microsphæra** platani, Howe.

Mycelium evanescent; usually on the upper surface of the leaf, but frequently spreading to the lower surface; perithecia globose, scattered, both sides of the leaf, .07 to .09 mm. in diamter.

Appendages 10 to 18; usually longer than the diameter of the perithecia; tips several times dichotomous, branchlets curved; asci 4 to 5, spores 4 to 5. On leaves of Buttonwood or Sycamore, *Pla tanus occidentalis*, October, common.

Also on *P. orientalis var acerifolia.*

19. **Microsphæra** Russellii, Clinton.

Amphigenous; mycelium arachnoid (cobwebby), thin; perithecia minute, prominently reticulated, globular or nearly so; appendages 8 to 16 or more, long and flexuose, usually transparent, but occasionally colored toward the base; tips one to three times divided or simple. Asci 4 to 8, spores 4.

Common on leaves of *Oxalis stricta*, October.

20. **Microsphæra** Alui (D. C.), Winter.

Hypophyllous; mycelium thin; perithecia globose, brown; .08 to .11 mm. in diameter; appendages few, scarcely longer than the diameter of the perithecia; colorless, tips several times forked. Asci 4, spores 4.

On the leaves of *Viburnum prunifolium*, August.

From C. H. Demetrio, Perry county, Missouri; not common.

ERYSIPHE, Hedw.

21. **Erysiphe** lamprocarpa (Wall), Lev.

Mycelium abundant; covering the foliage of the host with a dense mass of web-like threads; perithecia globose, .10 to .12 mm. in diameter; scattered or crowded. Appendages colored and so closely interwoven with the mycelium that they are with difficulty made out.

This is one of our most common species, and it occurs on many plants belonging to the Order Compositæ.

Common on Verbena urticifolia, Verbena stricta, Verbena hastata, Ambrosia, trifida, Ambrosia artemisiæfolia, Vernonia Noveboracensis, Helianthus sp, Aster sp. Solidago sp. Perithecial fruit occurs during the months of September and October.

22. **Erysiphe** Martii, (Lk.) Lev.

Mycelium evanescent; web-like; covering the leaves with a dirty white coat; perithecia globular or nearly so, prominently reticulated; dark brown or black; variable in size, but usually about .12 mm. in diameter. Appendages 20 to 30 or more, interwoven with the mycelium; .03 to .25 mm. long; transparent near the tips, but colored toward the base; tips accasionally forked. Asci 4 to 8, usually about 6; spores 4 to 8.

On cultivated peas, frequently very destructive, also on leaves of *Phaseolus helvolus* and *Phaseolus perennis*; perithecial fruit usually occurs during the months of August and September.

It is almost impossible to grow late peas in this section, owing to the ravages of this pest. The fungus attacks the leaves and stipules, causing the parts attacked to turn yellow, and finally to die. We have observed that this fungus is usually very destructive during the prevalence of dry weather. The white cobweb-like threads appear about the first of July, and it is not safe to plant peas after that date. We know of no remedies that have been used for preventing the attacks of this fungus.

23. **Erysiphe.**

On leaves of *Poa pratensis*, no perithecia.

List of species of Fungi and their supporting plants :

(Botanical name.)	(Common name.)
1. **Sphœrotheca** pannosa, Wall.	
Rosa blanda,	Early Wild Rose.
Rosa lucida,	Dwarf Wild Rose.
2. **Sphœrotheca** Castagnei, Lev.	
Taraxacum dens leonis,	Dandelion.
Vernonia sp.	Iron Weed.
Bidens frondosa,	Beggar Ticks.
3. **Sphœrotheca** Mors Uvae, (Schu.) Berk.	
Ribes Cynosbati,	Gooseberry.
4. **Podosphœra** oxacantha, D. C.	
Amelanchier canadensis,	Shad Bush.

Spirea,	
Prunus domestica	Cult. Plum.
" cerasus	Cult. Cherry.
Cratægus crus-galli,	Hawthorn.
5. **Phyllactinia** suffulta, Reb.	
Betula nigra,	Red Birch.
Cornus sp.	Dogwood.
6. **Uncinula** adunca, Wall.	
Salix falcata,	Willow.
7. **Uncinula** Americana, Howe.	
Vitis,	Grape.
8. **Uncinula** circinatia, C. & P.	
Acer dasycarpum,	Silver Maple.
9. **Uncinula** flexuosa, Pk.	
Æsculus glabra,	Buckeye.
10. **Uncinula** parvula, C. & P.	
Celtis occidentalis,	Hackberry.
11. **Microsphœra** diffusa, C. & P.	
Desmodium Canadense,	Tick-trefoil
12. **Microsphœra** extensa, C. & P.	
Quercus rubra,	Red Oak.
13. **Microsphæra** abbreviata, Pk.	
Quercus rubra,	Red Oak.
14. **Microsphæra** Friesi, Lev.	
Syringa vulgaris,	Lilac.
15. **Microsphæra** euphorbiæ, B. & C.	
Euphorbia corollata,	Spurge.
16. **Microsphæra** Ravenelli, B.	
Gleditschia triacanthos,	Honey Locust.
17. **Microsphæra** symphoricarpi, Howe.	
Symphoricarpus vulgaris,	Buck-bush.
18. **Microsphæra** platani, Howe.	
Platanus occidentalis,	Sycamore.
19. **Microsphæra** Russellii, Clint.	
Oxalis stricta,	Wood Sorrel.
20. **Microsphæra** alni, (D. C.) Winter.	
Viburnum prunifolium,	Black Haw.
21. **Erysiphe** lamprocarpa, (Wall.) Lev.	
Verbena urticifolia,	White Vervain.

Verbena hastata,	Blue Vervain.
Ambrosia trifida,	Rag Weed.
Ambrosia artemisiæfolia,	Bitter Weed.
Vernonia Noveboracensis,	Iron Weed.
Helianthus, Sp.	Sunflower.
Aster, Sp.	
Solidago, Sp.	Golden Rod.

22. **Erysiphe** Martii, Lev. (Lk.)

Phaseolus perennis,	Wild Bean.
Phaseolus helvolus,	" "
Pisum sativum	Cult Pea.

23. **Erysiphe ?**

Poa pratensis,	Blue Grass.

Genera..... 5.

Species..... 23.

THE FUTURE OF OUR CATTLE INDUSTRY.

An address by B. O. Cowan, Esq., member of the Board from Holt county, delivered at a Farmer's Institute meeting held at Columbia and at Kansas City.

The existence of cattle is so essential to successful farm management, that an intelligent discussion of our cattle industry will be of some benefit, I apprehend, to any convention of farmers. The question is so comprehensive that I deem it prudent to confine my remarks to beef cattle, excepting in the matter of statistics, which will necessarially include all cattle. Since an intelligent agricultural press and conventions of earnest cattlemen have sent forth the fiat, "The scrub must go," it will be superfluous for me to say that I stand here to plead for improved beef cattle.

No man could face this audience to advocate the scrub in comparison with the thoroughbred. There are plenty who are poor enough to own the scrub, but none so poor "to do him reverence."

Most of those engaged in the cattle industry of our country will readily endorse the sentiment of that practical ranchman who answered the objection of an eastern capitalist that his cattle were priced too high by saying, "Young man, I am not the son of wealthy parents, nor am I out here for my health;" hence I shall use facts rather than fancies, and figures of arithmetic rather than figures of speech. With a view of collecting some interesting figures relative to the sale of thoroughbred cattle in the past, I addressed letters to several representative breeders of the four most prominent beef breeds of our country, asking each one to furnish me with the following report:

1st. Names of one or more representative cows of his herd, with cost, or value.

2d. Number of calves produced by each cow and the amount received from sale of such produce.

3rd. Valuation of any calves not sold.

In response to these inquiries, reports were received from breeders of shorthorns, but very few from breeders of herefords, Aberdeen-Angus and Galloways. Why more of these gentlemen did not reply to my inquiries I can not state. I certainly had no intention of using such information in any way not strictly legitimate. And in the light of sales both public and private during recent years, there is no opportunity to make "odious comparisons," even if such had been my purpose.

In 1854 Mr. T. C. Jones purchased the Shorthorn cow, "Bonnie Belle Rose," for $125. Eight of her calves were sold for $2,220, and thirteen of her descendants are still in his herd.

In 1869 Messrs. J. H. Potts & Son purchased the cow "Belle B. Howland," 11 years old, for $98. She produded six calves after that date, and in 1877 she and her produce were sold for $1,800, which, in the language of Mr. W. V. Potts, "foots up pretty well for one old cow with a small drop of the much despised '17 blood in her veins.'" In 1876 these gentlemen purchased Fannie Airdrie at 14 months for $320. Since then $2,990 have been realized from the sale of her produce, while she and five of her descendants, Proud Duke among them, remain in their herd. In 1882, Messrs. Rigdon Houston & Son purchased a Phyllis cow for $165. Three of her calves were sold for $940, leaving dam and two calves in their herd.

Mr. Wm. Warfield reports the purchase of a Rose of Sharon cow at $125. She produced nine calves, eight of which sold for $3,095. Also London Duchess 2d., purchased at 6 monts old for $200. She produced 10 calves, 9 of which were sold for $16,670, and one retained at a valuation of $2,000, making $18,670. From produce of cow retained $4,900 were realized, making $23,570, as the result of the $200 investment, no deduction being made for interest, feed and labor. In 1882 Mr. F. McHardy purchased the Galloway cow Little Emily of Kirkcarmel, for $500. She has produced five calves, one of which died. For the other four $2,515 has been realized, and the dam still living. Messrs. Gudgell & Simpson bought the 24-year-old angus cow Black Cap for $700. They have sold two of her heifers for $4,000, and have the cow and three of her calves in their herd. Mr. Adams Earl bought the hereford cow Perfection for $325. She has produced seven calves, four of which were sold for $2,995. Mr. T. L. Miller reports a hereford cow valued at $1,500. At 11 years old she had produced nine calves, which were sold at an average of $600, or $5,400.

Such investments as these would undoubtedly keep the "gaunt

wolf" of starvation from any cattleman's door. These few examples show that handsome and in some instances enormous profits have been realized from money invested in good cows. And permit me to call especial attention to the fact that in most of these reports I have included only cows that were purchased at low prices—$98 to $325—which the great mass of farmers could afford to pay. More dazzling results could no doubt be given by quoting the sales of what are usually termed high-bred cattle, and one instance from this class was furnished by Messrs. Houston & Son. But since the high priced families of any breed are necessarially confined to the herds of a few men, they do not answer my present purpose as well as cattle that are within the reach of the majority of the farmers of our country. These examples, it is true, represent only profitable investments, and many could be given where loss instead of profit has resulted from the purchase of good cows at low prices. This, however, is no valid argument against the investment of money in improved cattle. There are plenty of men who would lose money if they should buy for $50 a cow worth $500. To successfully breed cattle requires something more than the necessary money wherewith to purchase the initial herd. It requires judgment and the ability and willingness to take care of cattle after purchased or bred. The man who invests his money in cattle, gives them no attention, but sits down and complacently waits for "something to turn up," will sooner or later find that it is the heels of his bovines instead of some good fortune that has turned up.

But since it is with future rather than past sales that we, as cattlemen are chiefly concerned, it may be more interesting to enquire what encouragement the future offers for the breeding of good cattle. In common with almost every enterprise of our country the cattle industry has been seriously affected by the general depression of the last two years. But may we not hope, yea, have we not good reason for believing the crisis has passed. Already the great commercial centers are responding to an increased demand, and with the revival of trade the demand for beef will increase, and in consequence the price will be enhanced. The production of good beef for the teeming millions of this and other countries will always give a fair return for the money invested, except during short times of general commercial depression. The growth of population in the United States and the increase in cattle have maintained near the same ratio during different decades of our history. In 1850 our population was 23,000,000 in round numbers and we had 17,000,000 cattle, or one and three-tenths of population to one head of cattle. In 1860 our popula-

tion was 31,000,000 and our cattle 24,000,000, or one and two tenths to one of cattle. In 1870 our population was 38,000,000 and our cattle 23,000,000, or one and six-tenth of population to one head of cattle. In 1880 our population was $50,000,000, and cattle 35,000,000, or one and four-tenths of population to one of cattle. An accurate comparison at this time cannot be made, since our population can only be approximated. The rapid increase in the number of our cattle, nearly 10,000,000, from 1880 to 1886, is no doubt due to the wonderful growth of the range interest during that period. This ratio of increase will hardly be maintained in the future, since the range country is already over-stockad in many localities, and the privilege of unlimited grass and water without money and without price, exists only in the memory of the successful ranchman. It has been estimated by competent authority that the population of the world is increasing in a greater ratio than the number of cattle. This is likely to be the case in the United States since the growth of our agricultural population will hardly keep pace with the growth of our cities and towns. This will undoubtedly be the case as our agricultural lands become more thickly peopled. Since our population is likely to increase at a more rapid rate than our cattle, it may be well in considering this question to ascertain, if possible, if there is likely to be a relative increase in the amount of animal food consumed. The *Breeders' Gazette* published a statement, on the anthority of the *London Times*, showing that the consumption of animal food in Great Britian in 1851 was 90 pounds per capita and 317 pounds of wheat, while in 1885 the per capita consumption of animal food was 115 pounds, and of wheat 400 pounds. Commenting on this wonderful per capita increase in the amount of both animal and cereal food consumed, the *Gazette* says:

"It is quite evident from these facts that farmers who are making meat production the principal feature of their business are engaged in something not likely to be overdone until the great laws which control the course and necessities of the everywhere growing population of the earth are completely reversed." This affords considerable encouragement for the breeder of good beef. Instead, then, of becoming discouraged on account of temporary depression and selling out for some other occupation, the prudent breeder will rather improve his herd and await the time when an increased demand shall again bring remunerative prices. I recently heard a farmer say he desired a good bull, but would wait until times were better before purchasing. Which, being interpreted, is this: He is willing to raise one or two more lots of scrub calves, when the difference in value between them and the same number of good calves would buy a good bull. If every farmer

and every business man acted on this motto it would be a long time indeed before times were better. The experience of many will attest the fact that the best time to invest in improved cattle is when times are dull, for in addition to having cattle ready to sell when the demand is suitable, the buyer has the benefit of the increased value of those bought. These occasional "low tides" in the demand for cattle are sometimes blessings in disguise. They are a benefit to the breed if not to the breeder's bank account. They cause a more careful culling of inferior animals, which on a flush demand are sold for breeders. A breed of cattle, no more than a breed of men, can stand uninterrupted prosperity. It must be salted slightly with adversity. The effort to produce the perfect beef animal is one of intense rivalry and continuous progress, and the man, or collection of men called States, who, because of having achieved distinction in breeding, rests on his temporary vantage ground and is content to herald his honor, will be surpassed in the contest. There is no passion ground. Advance or retire is the motto.

What dangers are there then that threaten the cattle industry? The answer at once suggests itself to every cattle man—pleuro-pneumonia. This is the chief danger. In fact, in comparison with it all other dangers are so dwarfed into utter insignificance that it may be said to be the only danger. It is not my purpose to quote statistics to show the number and value of cattle destroyed by this relentless scourge. Suffice it to say that in our own country it entailed a heavy loss of cattle and money, while in Europe at different time its ravages have been frightful, almost annihilating the cattle industry. Until recently, we have felt no anxiety on account of this disease, but its unexpected appearance at several different points in the Mississippi valley—at our very doors—has caused cattlemen to earnestly appeal to Congress for effective legislation on the subject. Thus far they have appealed in vain. County conventions, State conventions and national conventions, of cattlemen have passed earnest resolutions and sent able committees to urge upon Congress the necessity for prompt and efficient action, but no such action has been taken. Congress passed a law it is true, but not the law that cattlemen wanted, and that the cattle industry demanded at the hands of our national legislators. Why is it that such an appeal has not been satisfactorially answered? For the reason, first, that some cattle breeders and a large body of cattle dealers have persistently opposed the legislation asked for. In the second place, the measure meets the open hostility of some representatives and senators and the indifference of many more. Members who favor passing a law giving the commission appointed by the gen-

eral government ample powers to deal with the question, are met by those who claim that this matter should be regulated by the States, and who oppose any bill which seeks to invest the general government with the requisite authority, and each of these classes claims to be champions of the welfare of the cattle industry. Confronted by such conflicting opinions, the course of the bill for the suppression of pleuro-pneumonia reminds me of history of "Ginx's baby." For the information of those who have not read that pleasing satire, I shall give the story very briefly. Ginx was blessed with a very prolific wife. Additions to his family by couplets, triplets and quartets were made at regular intervals, until the astonished Ginx found himself the unhappy father of twelve children. He was poor, but a patient man, but finally decided that a point had been reached where patience had ceased to be a virtue. He thereupon remonstrated with Mrs. Ginx on her family ways, and gave her warning that if she presumed to present him with any more children, either singly, in pairs or otherwise, he would surely drown him, her or them in the river.

In one year from that date Ginx was presented with his thirteenth child, a boy. Taking the babe, he proceeded to execute his threat, and started for the river. On the way a kind sister of charity induced him to give the child to her, promising it sustenance and education. As soon as it was known that a Protestant child had been adopted into a Roman Catholic house, the Protestant Detectoral Association held indignation meetings and took legal advice as to how they could secure possession of little Ginx. The uproar of the Protestants and the perverseness of Ginx's baby, caused the good sisters to abandon their philanthropic purpose of training him for the glory of the church; so they baptized the youngster and turned him over to the Protestants. These worthy brethren thereupon fell to wrangling and disputing about young Ginx's spiritual welfare, but made no provision for his temporal interests. He soon became an object of charity, and went from bad to worse, until he finally ended his sad career by drowning himself in the same river into which his father threatened to throw him when a babe.

So amidst the conflicting opinions of friends, the apathy of those who are indifferent and the open hostility of enemies, the measure for the complete suppression of contagious pleuro-pneumonia seems likely to have a termination, in the present Congress, at least not altogether dissimilar to that of the unhappy Ginx.

In 1886, there were, according to the agricultural report, 45,510,630 cattle in the United States, and their value is $1,051,941,797. The total amount of money invested in the manufacture of iron and steel, and cotton and woolen goods is $546,572,252, but a little more than half

the value of our cattle. Each of these industries and many more have had their interests "protected" by national legislation, but the same authority denies the cattle industry the means of protecting itself. Where then is the remedy? Most assuredly in our national legislature. It is folly to expect to control and eradicate pleuro-pneumonia by State authority. Cattlemen can bring a pressure to bear on our Congressmen that will shake off the indifference of some and change the hostile views of others. Give them to understand that 45,000,000 cattle, worth over $1,000,000,000, are not to be jeopardized because of fine spun theories of State and national prerogatives.

It is well to pass resolutions in conventions and send committees to urge the measure in Congress, but it is better to make individual appeals. If every cattle breeder and farmer would appeal in person or by letter to his representative in the House, and give him to understand that his future vote at the polls would depend on the representative's vote on the bill to eradicate pleuro-pneumonia, it is quite probable that Congress would very soon pass an efficient law on this subject. With such a law in force, the future for American cattle is truly encouraging.

CATTLE.

A paper presented by F. W. Smith, Esq., member of the Board from Boone county, at the farmers' meeting held at Lancaster, Schuyler county, and other places, on The Four Principal Beef Breeds of Cattle.

MR. PRESIDENT AND GENTLEMEN: In presenting to you this paper I do not assume to be thoroughly conversant with all the details of the four chief cattle beef breeds of America, but I will present to you facts which experience of breeders over the land, observations on our continent and abroad, history and my own observations and experience as a breeder, have taught me to look upon as worthy of consideration by all interested in live stock, and this includes every farmer in the country.

We will consider each breed separately.

THE DURHAM.

This breed of shorthorns, as they appear to us in an improved condition, was before 1750 confounded with the varieties known then as Teeswater, Yorkshire, Holderness and Lincoln. At this period Charles Colling began to improve certain strains among them by the use of male breeders coming from certain herds in his vicinity, which had more reputation than the others, as good cattle. History goes to show that he probably selected his bulls from the herds of the Aislebies families, proprietors of the Shidly Park, and later, from the herd owned by Sir Hugh Smithton, which was in Stauvin, and to which the pedigree of the famous cow Duchess can be traced. This cow, as we are aware, was the founder of the celebrated Duchess family still in existence.

It was not until 1785, however, according to the Zootechnist Sanson of France, that Charles Colling gave a decided impulse to the

improvement of the short-horn or Ex-Teeswater cattle, by the acquisition of a bull named Hubback, whose genealogy (or pedigree) has been greatly discussed, but who is nevertheless supposed to have been, like Duchess, a descendant of the herds above mentioned.

Before the improvements of Colling began, the average weight of meat produced with the Durham varieties was perhaps seventy per cent. less than now for the best matured steers. Ten years after he began, he produced an animal that weighed, at five years old, 2,740 pounds. This enormous weight, due to the fat, has seldom been attained since. This animal was a phenomenon which was placed into a wagon and paraded the streets of the cities and towns of England, and traveled the country over under the name of "Durham ox." At one time $10,000 was offered for him and refused; he, however, had to be sacrificed sometime afterward through an accident which happened to him.

The shorthorn is an early maturing breed; at forty months old the evolution of their adult teeth has sometimes completely finished, and the animal is practically an adult. This precocity, however, is not due to the nature of the breed exclusively, but also to its treatment by the breeders and its surroundings; for if those conditions are not attended to in a proper manner, they will mature later as any kind of cattle would—comparatively speaking—if placed in the same circumstances.

So that the influence of selection in the reproductors, proper care and feed are of necessity to improve in short-horns, the natural tendencies to fatten and make beef, which tendencies have been transmitted by heredity. And, by the way, this principle holds good in every breed of beef cattle. The members of the very best families may become of little account individually, if not properly attended to. The natural dispositions or predispositions of a breed of cattle are aided by intelligent breeding, wise crosses and careful attendance in surroundings and feed.

The nature of the shorthorn, like that of other beef breeds, is its natural predisposition to make good beef in a short period and fatten comparitively easily, especially after the first year, with less food for the same weight of body than the scrub cattle of the same age. It is consequently essentially a beef and fat-producing animal, and not a milker in the true sense of the word, giving not much more milk, as a rule, than is necessary to raise their offspring in a proper manner.

However, shorthorns are said by some to be adapted for both dairy purposes and beef makers. It is true that certain families of shorthorns are fair milkers, and that among them we find occasionally

an extra milch cow; but this is an exception, and truly speaking, they do not give the rich quality, nor even the quantity, of milk wanted in a milch cow. The quantity is, however, sometimes superior to the quality.

On general principles, and speaking of every breed, by the way, I do not believe that it is possible to concentrate in one cow or set of cows, first-class milk and first-class beef qualities. A cow which is a perfect milker is a medium feeder or beef cow, and *vice versa*. The farmer who will raise thoroughbred shorthorns to make butter and beef, will not, as a rule, realize much profit from the former industry. He will do better in this respect with an animal produced by the cross of the shorthorn bull with a good ordinary milch cow of good, round conformation. Indeed, by this cross, one may expect a fair general purpose set of cattle, i. e. an average paying milker and beef subject.

Now what is needed by the average farmer is a kind of cattle that will mature early, fatten from the time one begins to feed it, and produce at least sufficient quantity of good milk for home use, unless one has both special milk cattle and beef cattle, in which case, a good net gain may be derived both from the milk production and the beef. But I am dwelling on beef breeds here, to make profits with them, the sooner a steer can be placed on the market the better for the owner, and no steer should be kept more than two years on the farm. My experience has taught me that no breeds or varieties of cattle will accomplish this as easily as a steer from a cross between a shorthorn cow and a hereford bull. It is for me the type *par excellence* of feeding cattle, so far as I have been able to judge from what has been accomplished by various breeders and feeders and myself. I will touch on this point again in speaking of herefords.

But as every farmer may not be in circumstances to purchase shorthorn cows and a Hereford bull to steer with, let us point to one practical way of producing a good paying steer out of the shorthorn, for those who prefer that breed. A thoroughbred shorthorn bull can now be bought for $50 or $100, and its cross with a rounded, short legged, plump scrub cow will produce a steer much superior to the scrub steer. It will fatten more easily, will mature earlier, and will make better meat. It will produce an animal that can be sold for good money at two, or two years and a quarter. When a steer is fed three years, it has eaten its head off, in many cases.

The shorthorn cattle have been before the American people for many years—longer in fact than any other thoroughbred beef breed now in preference, and they have justly won a magnificent reputation. Of late years, however, the stimulation created in the country by the

plausible enthusiasm of breeders and cattlemen generally, over the results of various breeds as meat and milk producers, caused the importation of other breeds, which now dispute the shorthorn laurels, at the shows and on the market. These breeds are the Hereford, which came out victorious at the Chicago and English fat stock shows this year, and the Galloways and Angus, which have justly many admirers and deserve the attention of the country, for the many important points in their nature.

THE HEREFORDS.

This breed, improved as it is, originated 117 years ago, Sanson tells us, under the management of Benjamin Tompkins of Hereford county, England. Before that, the cattle of that county were distinguished for their aptitude to produce milk of a superior quality, and in good quantity. In 1769, says Prof. David Law, Mr. Tompkins, a dairyman, noticed among his herd two cows with a peculiar tendency to fatten instead of developing the udder, and he at once conceived the idea of breeding them to get beef stock. One of these cows was a light gray and the other a fine red with a mottled face. The first was named "Pigeon," and the other "Motley."

Another version of their origin is that it was from a bull born with a white face, on the farm of Mr. Tully of Huntington, near Hereford, and whose offspring would have been also born with white faces, and so on. These points are of no great practical importance, however.

It is a breed which, no matter what its origin was, has been kept free from any foreign blood since over a century, when their uniform color and shape had become ascertained, for, cattle of Hereford county were at one time red and mottled, and we believe their history.

Thus, the herefords of to-day have lost in a measure their great dairy qualities of a hundred years ago, and have inherited in some way or gained by certain means, the great beef and fattening tendencies that Tompkins discovered in "Pigeon" and "Motley;" and probably these tendencies have still augmented since his time. And consequently they are to-day, as a breed, a producer of milk in little quantity but of good quality, and a most excellent beef producer, whether pure or crossed. The qualities of the crosses, although generally excellent, vary of course according to the strains crossed with. The hereford breed began to draw attention in America about ten years ago. Since that time they have made wonderful progress, and this year they have taken the grand sweepstakes at the Chicago Fat Stock Shows, and the Smithfield Fat Stock Show in England.

The nature, conformation and tendency to early maturity of these animals, make of them a very desirable lot for the farmer. They have a thick mellow hide, heavy suit of soft hair, are short legged and well proportioned in every respect. The thoroughbred always has a white face.

They can stand cold and inclement weather, in general, better than the other beef cattle. Those qualities make of them a set of animals well adapted to the field in perhaps any climate. As grazers they are unsurpassed if equaled by any. I speak from personal experience and observation, and do not by any means intend to be partial to any one breed, or to any variety of cattle. For the above reasons the herefords are much sought after by the ranchmen, and undoubtedly the farmers may find in them a most desirable breed to improve their stock and create for themselves families with paying qualities.

The herford's ancestors having been excellent milkers, they retain to day a part of that quality, which makes them superior, perhaps, in this respect, to the average other beef breeds which have probably always been essentially meat producers. Hence the offspring from them and an ordinary fair milker and well shaped cow, has a better chance to have fair milking qualities, without losing any of the properties desired and existing in the hereford. But, I repeat again that no one cattle, in my opinion, can be made a first-class milker and a first-class beef producer at the same time. The hereford is perhaps the earliest of the early maturing breeds. It begins to fatten in a uniform manner from the moment one feeds it. Being a good grazer, it is easily and economically fed and brought to the fat condition most sought for by the butcher. A steer can always be sold at about two years. Its crosses with ordinary cattle makes good farm cattle, that will supply milk for the house, make some butter, and make steers that may be sold with good profits at two years of age.

I know of no cross so far, that will fatten so easily, so economically, and mature so early as the hereford bull and the shorthorn cow crossed. I have made the trial and have noticed this fact from the teachings of the fat stock shows, which are good schools on such matters. If the farmer in ordinary circumstances cannot get a hereford bull and shorthorn cows, he may perhaps start with the next best thing—the thoroughbred hereford bull and the grade shorthorn, or the next best thing to this—i. e., the thoroughbred hereford bull and the best all around scrub cow, or crosses he may have or may find. The worst production from such crosses would be superior to a scrub. Steers produced by this last cross would be 20 per cent. superior in every respect as beef cattle than the scrub steers. They will be brought to market 10 per cent. cheaper and will sell 10 per cent better.

Again, the hereford might be crossed with first-class, well proportioned, ordinary milk cows, or ordinary farm cows; and from the heifers thus produced, steers of first-class quality will be raised for market supply.

Crosses between the hereford and the galloway and angus have also given magnificent beef cattle.

ANGUS CATTLE.

This breed is, I believe, the most noted in the country of the two beef breeds called polled cattle, or black muleys. They are usually called "Polled Angus." Their origin is obscure. The authors say they descended from an ancient breed called "Brittanics" or "Brittanicus," which were dark colored cattle. As they come to us, they are supposed to have had their source in Scotland, and they are not far from the variety known as galloways, of which we will speak further.

The angus are black cattle and have no horns. They are an early maturing breed and very well proportioned to fatten. They have round bodies, are blocky and their hair is smooth and short like that of the shorthorn, from a cross of which breed, some say they are derived—a point by no means proven, or even elucidated.

They are not naturally well adapted to graze, but for stall fed cattle I believe they can not be surpassed by any present American cattle. In fact they are a first class beef cattle, but are only medium milkers.

The champion of the Kansas City Fat Stock Show this year was a thoroughbred two year old angus steer. Their offsprings from crosses with the shorthorn are good, but they do not always inherit the uniform black color of the angus. Sometimes they are gray or spotted, and sometimes they have horns. Nevertheless, they make a good beef animal, probably better suited for the field than the pure angus itself. But their cross with naturally good grazers, such as the hereford, would produce a more desirable subject perhaps to be raised outside. So far as our knowledge goes, I am inclined to think that the angus should be kept purely for stable feeding.

A beautiful specimen of a grade between a hereford and polled angus was shown at the Chicago Fat Stock Show, and was said by some to be superior to the sweepstake winner. His name was "Nigger," and he was owned by the Wyoming Hereford Association.

GALLOWAYS.

This breed of beef cattle, which is an older one than the angus, with which they are supposed by some to have some relation, is said

to have also originated in Scotland, and to be also a member of the variety called the "Brittanics." They are of a black color like the angus, but distinguish themselves from the latter by their rather long, coarse hair and large bones. They have no horns, and much speculation is indulged in as to whether they (and the Angus) lost their horns by a freak of nature, or were originally a distinct race without horns. We are told on good authority, Sanson, for instance, that writers of ancient times described a dark cattle without horns.

They are a pretty good grazing cattle, better than their angus friends. They do not mature as early as either of the previously mentioned breeds. They, nevertheless, fatten easily enough. This cross with the shorthorn gives better results than the angus with the same. It generally produces a uniformly black and hornless animal, and whose tendencies to fatten usually well rewards the intelligent feeder. They are in a pure state only medium milkers. I could not give an opinion of much value as to the richness of their milk, nor of the crosses with any other breed than the shorthorn, because I have not been able to gather much information on these two points.

The galloways are said to stand the cold remarkably well, but not quite as well, the heat. They are, as a breed, a good lot of cattle, which may prove to be very suitable to farmers. They are, in a word, justly praised as meat producers. The experiments which are to be carried on by Professor Sanborn on the Missouri Agricultural College Farm, with these four breeds of cattle, viz.: the shorthorn, the hereford, the angus and the galloway, will undoubtedly determine the exact nature of the four breeds as to their qualities as beef cattle. In fact, no one breeder is sufficiently informed as to the different good and bad points of these four lots of cattle. For my part, my personal experience has been chiefly with the herefords and shorthorns, and I would necessarily have to be brief on the others in regard to which I have but limited data. The four chief beef breeders' associations of the country have donated to the Agricultural College ten steers each, viz.: ten shorthorns, ten herefords, ten angus, and ten galloways, of the very best class to experiment with in various ways of feeding, etc.

The undertaking in our own State, on our State Agricultural College Farm, with most valuable animals sent from various parts of the United States, is one of the greatest, if not the greatest that the animal industry of the universe has ever undertaken at one time; and it is an honor to our State that its State Agricultural Farm should have been recognized, with its efficient managers, as the proper place to carry on such important experiments. If our legislators have at heart the prosperity of our commonwealth and appreciate the honor conferred upon

her by that action of the stock breeders of the United States, they will surely not hesitate to assist the managers of the farm in providing whatever it may lack to make this great enterprise a success.

In conclusion, I will give a few figures to show that it pays better to sell steers at an early date, and that the variety of cattle needed, if we want to make money with beef, is the one that will mature the earliest.

The average age and weight of three and two year old steers at the Chicago Fat Stock Show were as follows:

Three years' class steers, 1,386 days, or 3 years 9 months 21 days, 1,998 pounds.

Two years' class steer, 923 days, or 2 years 6 months 13 days, weight, 1,571 pounds.

Thus the three year old steer (nearly four years) was 463 days older than the one in the two year old class, and made only 427 pounds more, or less than a pound a day, and this too with intense feeding. A pound a day with intense feeding hardly pays at the value of feed, and less than a pound a day does not pay even at grass and little extra feed. Hence, better endeavor to get steers sufficiently fat in the first two years when they daily increase much more than that with comparatively less food.

We feel convinced that the average agriculturist can arrive at that result, and thereby add a paying industry to his productive soil—an industry which is now too sadly neglected and looked upon by many as accessible only to the specialist-breeders, or rich men.

GENERAL AGRICULTURE.

Address delivered by Abiel Leonard, Esq., member of the Board from Saline County, at Jefferson City, January 17, 1887.

MR. CHAIRMAN—I have just a few words to say upon the subject of general agriculture. I take this subject because it is one in which I have been engaged all my life, and one also in which I take a deep interest. When I say that I have been engaged in it I do not mean that I have ever given much thought or study to it, for I have not, and the consequence is I now have a large stock of experience and but a small amount of positive knowledge and information in regard to it. I never realized until I began to think about what I should say at this meeting how little I really do know about agriculture, and my opinion is that most of you, if asked to deliver an address or prepare and read a paper on any particular branch of agriculture, would realize the same thing. If you do not believe this, and some of you think you are well qualified, this would be a splendid time for you tell what you know, and how you have learned it. Of course we all know that farmers as a rule are neither orators nor speech-makers, but this is no reason for not telling what you know. A few simple words full of knowledge and information, well spoken, and to the point are far more eloquent and more effective than a mass of high sounding words and phrases thrown together in a meaningless jumble. There is not one of us but has sufficient control of the language to tell all and much more than we know. The question then is: What it is we really do know? In order to make myself plain, I will ask a few simple questions and if you will answer them correctly, I will feel that I have been highly paid for coming here. In the first place then, have you learned what is the best kind of a plow with which to break your ground—when to plow it, and how deep to plow it? Do you know how many pecks of wheat or oats or rye to sow to the acre, how many grains of corn to plant in the

hill, and how far apart to plant them? Have you learned when to cut your timothy and clover so as to get the most and the best hay from it? When to cut your wheat and oats so as to get the heaviest, brightest, and plumpest grain from it, and also the best straw. Of course we all have our opinions about these matters, but are these opinions substantiated by facts? If not, what are opinions worth unsubstantiated by facts? Suppose I should say that four pecks of wheat being sown to the acre will yield a larger crop than if six pecks or more were sown. Of course there are many of you, who would differ from me, but are you prepared to deny this statement, and prove your denial by having made such an experiment as will convince your hearers that you are right and that I am wrong? Suppose that I should say that two grains of corn being planted in hills two feet apart each way will yield a larger crop than if four grains were planted in hills four feet apart each way. Are you prepared to deny and prove this in an equally satisfactory way? Suppose that you should have a thousand barrels of corn and a hundred tons of hay, you naturally wish to get the highest market price for it; to do this you would convert it into beef and pork, or wool and mutton, or something else besides the raw material, do you know how to prepare this food; in what proportions and quantities to feed it, or what aged animals to feed it to, and how long to feed them in order to get the largest amount of clear money for your labor? no, I can not answer one of these questions positively and I am not acquainted with a farmer in Saline county who can or will. I do not admit that I or my neighbors are below the average farmer in intelligence and enterprise, and yet these are questions with which we are every day dealing and our success in agriculture depends upon our knowledge of them, for how can any business be carried to success when such ignorance of its principles are displayed in the management of it. It is generally supposed that if a young man is unable to carry on successfully, any business, he is a fit subject to become a farmer. I believe there is both truth and philosophy in this statement, because there is no business that will admit of so much ignorance, stupidity and carelessness, and yield a man the necessaries of life. In my opinion farmers know less about their business than any other class of men. I do not hesitate to make this statement, because I am a farmer, and one who has suffered through ignorance and bad management on my farm.

What I mean by that management is this, that my farm does not produce but little more than half what it should produce and fully half of that is wasted. If this is not the case why is it that farmers in such States as Maine, New Hampshire, Vermont and other New England States, with a barren rocky soil, a climate that gives them eight

months winter in the year, are competing, and successfully, with the farmers of Missouri, Illinois and Kansas, with a soil and climate unequalled for the production of live stock and farm products.

I lived in New Hampshire once for four years. I went to school at Hanover and while there I boarded with a farmer; he owned and operated an eighty acre farm. It was a well improved farm and that is all that can be said in its favor, with houses, barns and fences made of stone taken from the 80 acres, and yet there seemed to be enough left to cover every foot of space on the surface of the farm, but what was the result of his labors on his farm as compared with mine or any other Missouri farmer? This farm of 80 acres supported a family of eight people, who were all well fed with an abundance of wholesome food, were well clothed, and were being finely educated; none of them worked too hard, and seemed to have an abundance of time for pleasure and were happy and contented.

Now what is a farm of eighty acres in Missouri good for? So far as I know, it is good for nothing. A Missouri farmer don't get room to turn around on and store his farming utensils on eighty acres. A Missouri farm of eighty acres was never known to support anybody or anything comfortably. I have a farm of 800 acres in Saline county and it is a very good one. I work much harder than the New Hampshire farmer, I raise a great deal more corn and wheat and oats and feed a great many more hogs and cattle, but what does all this labor and capital invested amount to? Well, it just about supports me and my family, and keeps my farm in repair. Now why is farming in New England more profitable than in Missouri? In one word, it is because they economize and we waste. Economy is the watchword there, waste and neglect is the order of things here. I believe there is more health, more wealth, more religion, more happiness, more morality, more contentment, on a farm of one hundred and sixty acres well cultivated and cared for, than on a farm of one thousand acres with the present system of farming in the Western States. I believe that ninety-nine farmers in one hundred are failures. Failures because they do not get the comforts and pleasures of life that they would with the proper management of their farm. There seems to me to be less improvement and less progressiveness among farmers than any other class. Take me and my neighbors as an example, for instance, and how much better prepared do you find us to operate our farm now than we were ten or fifteen years ago. I do not mean in the way of increased bank accounts, because as a generel thing they are smaller or in the better improvements we may have, but how much more do we know of the soil we are cultivating, the crops we are raising, the live stock we are feeding and marketing every year; how much more grain and hay are

we raising, and at how much less cost; how much more beef and pork we are making in proportion to the amount of grain and hay fed, and how much greater is the profit now than at some future time. You may be looking after such matters differently here to what we are doing in Saline. We are doing there now as we have always done. We do not exactly know what we are doing. Sometimes we plow deep and sometimes shallow; sometimes we sow a bushel of wheat to the acre, and sometimes two and a half; sometimes we crush the clods with a roller and smooth the surface with a harrow, and sometimes we do not. If we fail to use these tools we console ourselves with the idea that it was better not to have used them, as the uneven surface and heavy clods will prevent the wheat from freezing out in the winter. The year rolls around, we cut our crop, we thresh the grain and burn the straw. We sell the grain for from fifty to seventy-five cents per bushel. Of course the times are hard and we complain bitterly of them, but that does not improve the matter. Our wives and daughters are worn out with overwork and little recreation, because we can not afford to hire some one to help them do the work; our boys are mad at and disgusted with the farm; they don't have any fun; they work hard, wear course clothing, and their city friends look down on them as one "gallowsed" country jake that is unworthy of recognition. The old gentleman is unhappy and dissatisfied, and would sell his farm at half price if he could find some one to offer him that much, but he can not do it, so he makes up his mind to struggle on; he borrows money with which to buy the necessaries of life, he can't pay the interest, the debt grows larger, the crop smaller, he is finally sold out lock, stock and barrel—the end has come at last and he thanks God it is as well with him as it is. How many of you have seen just such cases? I have not lived as long as some of you and I have seen many, and expect to see many more. All this talk about the independence of a farmer's life is nonsense; there is but little independence connected with it; most of us are bound hard and fast with mortgages, and ten per cent. is our master. That kind of talk reminds me of the boy who whistled in the dark to keep his courage up. Now I have not spoken this way of farming and the farmer in order to find fault, or because I am dissatisfied with farming, because I was never more in earnest in my life or more determined to make farming and stock raising a success than at the present time. If there is one business that should occupy a higher place than any other, I believe it is agriculture; if there is one class of people that should be more honored, more respected, and hold a higher position socially than any other, I believe it is the farmer. Ag-

riculture is our chief source of wealth. Our agricultural interests are greater than all others combined, and first in importance not alone because of its wealth-producing power but because of the numbers engaged in it, almost our entire population being directly or indirectly supported by it. Then let us work to place ourselves and agriculture upon that plane which God intended we and it should occupy, above and beyond all others to do this. We must educate ourselves and children, and make it easy for them to practice those methods which give the largest returns for their labor. I will not undertake to tell you how to do this, for there are those present who can and will tell you better than I can, but I will make you a promise, which is this: I will from this time forth do all in my power to demonstrate that farming can be made both pleasant and profitable in Missouri.

TILE DRAINING.

Read by Levi Chubbuck before the Missouri Farmers' Institute, January 19, 20 and 21.

In presenting to the meeting the subject of tile draining, it will be my purpose to awaken thought among the farmers of Missouri as to the need and value of draining, rather than to go into an explanation of how the ditches are dug, and the tiles laid and covered. There are numerous works on draining, some of which it would be well for a farmer who intends to do any draining to have, and carefully study. It is work which calls for the exercise of a large amount of intelligence and skill. It is work also that when done well is permanent, but if poorly done is soon rendered useless, and as the cost is necessarily comparatively great it behooves the farmer to understand well what he is undertaking.

But, as intimated above, the first step is to show to the farmers of this State the need and value of draining.

While many of our farmers are awakening to the needs of their farms in this regard, it must be admitted that as a State, Missouri is woefully behind many of her sisters in this work.

The work of tile draining in this country has all been done in the last fifty years, and at the present time the highest type of agriculture is to be found where the most tile has been laid. Mr. John Johnston, who is known as the father of tile-draining in this country, began the work on his farm near Geneva more than forty years ago, when the expense was much greater than it is now, the tile costing about $24 per thousand, and although his neighbors laughed at him for, as they said, "burying his money by putting crockery in the ground," he continued to buy and make tile until he had buried 210,000 in the soil and had 300 acres of land in such a state of cultivation as had never been seen before by the neighbors who had so recently been laughing at him.

Mr. Johnston stated that the investment returned a profit of 100 per cent. yearly, and that the cost of underdraining will pay for itself in ten years.

But underdraining is by no means a modern discovery, as many of our farmers whose attention may have been called to it but recently may think. It is an art running back further than do our historical records, and writers of the Greek and Roman empires, two thousand years ago, mention this means of removing surplus water and adding to the fertility of the soil, as not then a new idea. Virgil and Cato wrote of open ditches and drains, while Columella, who lived in the time of Christ, mentions covered ditches. These were filled with stones, brush and straw, so as to afford the water a channel through. Some of the fields of the modern Persians are supplied with underdrains for the passage of water from places where there is an excess to where there is a lack, and no one knows when and by whom these were constructed.

There exists in a garden in France a thorough system of underground tile draining with hard-glazed earthenware pipes, ten inches long and four inches in diameter, which were made and laid some time during the dark ages by some French monks who lived there. It were these monks who, during that benighted period, preserved what was preserved of literature and the arts; and in this system of draining the garden, on which they largely depended for sustenance, it is seen that they also were preserving the life-giving art of agriculture.

It is to the English, however, that the credit is due for the elaboration of the system of tile draining and bringing it to a high state of perfection; and in that country its adoption is almost universal on lands needing drainage. It is right here that those who advocate tiling in this country are met with the statement that what is useful in England is not necessarily so here. England, they say, has a moist climate and frequent rains. This is all true; yet it is not true that England has a larger precipitation of moisture than the United States. On the contrary, we have in this country more moisture deposited in the form of rain and snow in the course of the year than in the moist climate of England; but it is less evenly distributed, and for this reason drainage is even more essential here than there, as we will attempt to show further on. The same objection is raised by farmers of the West that draining may be necessary for the swamps and peculiar soils of the East, but on our rolling prairies it would be a useless expense. Missouri farmers say that if our land was like that of much of Illinois, flat and undrained naturally, we would need to do as they do. Because farmers have learned that certain methods of farming

which are applicable in one section are not in another, or on one farm and not on another, they have, the wish being father to the thought, concluded that although underdraining is profitable and necessary in some sections it is not, to much extent, here in the West. It is no wonder that farmers should desire to escape the great expense of tiling, often equal, or even greater than the first cost of the land, if possible, and it is wise for them to consider well the need of it before undertaking the work. We want, then, to determine if our land in this State needs underdraining.

There is, of course, the question of whether it will pay or not, consequent upon the cost, and whether the land lies near enough to market so that the extra yield of crop can be sold to good advantage; but in this age there is but little land in our State which is so far from markets as to be affected to much extent by this question, and the labor involved will not cost much more in one section than in another. The cost of the tile will be greater when it has to be transported a long distance than if made where used, but it only needs a demand to cause a supply to be provided at home. Tile factories are very plentiful all over the State of Illinois, and they are springing up in this State. We therefore come back to the main question, "does the land of Missouri need draining?"

A French writer on drainage tells thus tersely what lands need be drained: "Wherever, after a rain, water remains in the furrows; wherever stiff, plastic earth adheres to the shoes; wherever the foot of man or horse makes cavities that retain water like so many little cisterns; wherever cattle are unable to walk without sinking into a kind of mud; wherever the rays of the sun form on the earth a hard crust, slightly cracked, and compressing the roots of plants as in a vise; wherever, three or four days after a rain, slight depressions in the ground show more moisture than other parts; wherever a stick forced into the ground eighteen inches deep, forms a well-like hole, leaving standing water at the bottom; wherever tradition says it is advantageous to cultivate the land in ridges." Are there many farms in Missouri on which some of these conditions do not apply? Indeed the farm will be rare and hard to find on which there are not portions of land presenting some, or all of these features. The writer has worked soils in widely separated portions of the State and has seen those of a large part of it, and but little has been seen which appears as though it did not need draining. In the section and on the farm where most of my life has been spent, there is not a condition given in the foregoing quotation which does not apply; yet it has been, and is yet, the general opinion of the farmers in that section that draining is not needed there, simply because the land is somewhat rolling, thus allow-

ing the water to run off on the surface. That the surplus water does not escape readily enough in this way, is evident, when I think of teams miring down in the public highway, as I have often seen done, in the spring and fall. While to drive into the fields with an empty wagon is impossible when the ground is completely saturated; and a hard day's rain will often put the land in such a condition that it cannot be worked for several days.

When there is sandy or gravelly subsoil underlying the surface soil which allows the surplus moisture to readily pass away, then under draining is not needed, but such land is not common and is, on the whole, not so desirable as that of a more retentive texture when properly drained.

Admitting without further question that tile draining is beneficial to our Missouri lands, (and it can no longer be questioned, for enough of it has been done in all parts of the State to thoroughly demonstrate its value), let us consider how it does good. In support of the statement that drainage is beneficial I will submit a number of propositions, the truth of some of which will be so apparent as to need no explanation:

1. *Drainage Removes Stagnant Waters from the Surface.*—A farmer need not be told that water standing on the surface of a field is detrimental to almost all crops, and if it remains there long is fatal.

2. *It Removes Surplus Water from Under the Surface.*—While moisture must always be present in the soil in which plants are growing; and excess of moisture is highly injurious; and, as the saying is, but few agricultural plants will live long with "wet feet."

3. *It Lengthens the Season of Labor and Vegetation.*—This is evident when we remember that from one to two weeks is usually spent by the farmer in waiting for the land to dry out sufficiently to work, after the weather has become warm enough in the spring. A week or ten days start in the spring will often, as all farmers know, make the difference between a half and a full yield or saving the crop from ruin by an early frost.

4. *Drainage Warms the soil—And aids in this way to lengthen the season.* When the waters from rains or melting snows cannot run off on the surface or through the soil it must be "dried up" by evaporation, that is, it must be changed from the liquid form into vapor when it will float off into the atmosphere. Now, those who have studied natural philosophy or physics understand that when water is evaporated a large amount of heat is absorbed or made latent, as it is said. A demonstration of this fact is when one wets his hands and then holds them in the wind, they will be suddenly and sharply chilled.

This is due to the evaporation of moisture from the skin and the consequent absorbtion of heat.

Those of you who have ever attempted to melt snow or ice on the kitchen stove (your wives have perhaps had more experience) know something about the amount of wood it takes for the purpose, and how cold the room seems while the melting is going on. It is because the heat of the stove was being absorbed and rendered latent in changing the water from solid to a liquid form. It takes more than five times as much heat to evaporate a gallon of water as to raise that same amount of water from the freezing point to the boiling, when evaporation goes on most rapidly. It has been estimated that to evaporate one-half of the water that falls on an acre in the course of a year would require, of the sun's heat, an amount equal to that from burning 219 tons of coal. It can readily be seen that if this heat of the sun can be expended in warming the soil in the spring, instead of evaporating the surplus moisture, it would be in a condition to receive seed sooner than otherwise, and with much less liability of the seed rotting before germination.

The evaporation of the water not only extracts heat from the soil, but its presence in and on the soil prevents the heat of the sun from penetrating, because of its being a non-conductor. To heat a kettleful of water from the top would be a very difficult task. By placing the kettle on the fire the heat passes through the iron, heats the particles of water in contact, and these by expansion become lighter and rise to the top of the vessel, and thus allow other particles to come next to the hot iron. This constitutes the heating and boiling process of water, and it is the rapid expansion and rising of the heated particles from the bottom that makes the bubbling. Now if the heat was applied on top, the heated and lighter particles would remain there and water at the bottom remain cold. If, therefore, we remove the water by draining from the soil, the sun can more readily pass through the soil, which of itself is a better conductor of heat than is water.

The removal of water from the soil by drainage affords another means of warming it. It is well known that, in the early spring, the soil is colder than the atmosphere and the rains, which fall. If a way is provided for this water to pass directly through the soil, it will have an appreciable effect in raising the temperature.

5. *Thorough Draining Prevents Surface Washing.*—There are but few farmers in this State who will not say that this is one of the hardest things to prevent. Our rain storms come with such suddenness and copiousness sometimes that it seems as though the water fell in sheets, and in a few minutes the fields will look like lakes. This water, in its rush to a lower level, seeks the shortest and easiest way,

and if the volume is great enough carries with it soil, plants, fences, and whatever it can. Now the tendency of the water is to obey the law of gravitation and go straight down, but if the soil is already full of water, or is of a close texture and it cannot obey the law directly, it will do the next best thing and run down hill, making gutters as it goes. By draining we remove the water that is there and give these sudden showers a chance to penetrate. The drainage also pulverizes the soil as deep as it is drained, and thus fits it to absorb large amounts of water. It will be readily understood that if a soil is in texture something like a sponge for four feet in depth, it will absorb a large amount of moisture before any will run on the surface.

6. *That Drainage will thus fit the soil, or, in other words, deepen it, is evident.* None of the plants grown on the farm will grow with their roots in stagnant water, and if we put drains down into the hard-pan, so as to let the moisture out of it which has been held there so tenaciously, we deepen the soil to that extent, and roots will be found to go thus far, whereas before they had not penetrated that stratum. Many are of the opinion that if tile is laid in this tenacious clay or hard pan underlying a large portion of this western country, that the water would never get into them. There need be no fears on this point, for while we make ponds and cisterns in this clay which, apparently, hold water, yet it does pass through, though but slowly; and when a tile drain is laid from two to four feet deep, thus affording a regular passage for the water, it will be found that, though the water does not ooze through the clay very fast, it will shortly be so modified as to afford a ready passage, and as has always been found to be the case, the drain will improve in efficiency for a number of years. Giving the roots of plants a chance to descend into this clay will aid much in loosening it up and opening passages for the water.

7. *Thorough drainage prevents injury from drouth.*—It may sound absurd to say that in draining the surplus water away from the land, we thus provide against a time of scarcity of rain water, yet it is even so. If the points made under heads five and six, that drainage allows the rainfall and melting snows to pass through the soil, rather than over the surface, and that drainage deepens the soil, are well made, then it is evident that the statement is correct that drainage prevents injury from drouth. In other words, we have provided an outlet for nearly all of the rainfall through the soil and at the same time put the soil, down to the depth of the drains, into such a condition of texture that a portion of every shower is held as in a sponge for the use of the plants growing in it. We had before draining perhaps a foot of soil which would become thoroughly saturated in a smart shower, and which must be dried out before it could be worked; now we have in-

stead four feet of soil, the absorbing power of which is greater than that of the one foot, and which will take in two or three days' rain, let it sink to a lower level and while it is running off through the drain the surface can be worked. We have here a reservoir for plant water four times as great as before, besides the increased capacity of the soil to hold water, this being given up to the plants in time of drouth, by capillary attraction and the power which plants have of extracting moisture from soil.

Missouri farmers know what drouths are, and could afford to pay a fabulous price for means to counteract their devastating effects. A very common remark is: "Give us seasonable rains and we have the best farming country in the world." We believe that in thorough tile drainage lies the most practical and effective remedy yet known to man. We know that texture and condition of the soil has much to do with its power to sustain plants in times of drouth; that an abundance of rain in some seasons, when falling upon and running off on the surface, seems to make the soil suffer all the more when a dry time does come. And again, if the soil is in the right condition, a small amount of moisture seems to answer the purpose.

I remember the summer of 1864, I think, when in the part of the State where I then lived (Daviess county), we had no rain from before corn was planted until after it was cut up in the fall; yet we had twenty-five bushels of corn per acre. The land was new, only a few years from the prairie sod, and the texture of the soil seemed to be such that it did not dry out as it does now.

Time will not permit my dwelling upon the benefits to be derived from drainage. There are many which I have not mentioned. I might speak of how the air by thus passing into the soil affects the soil constituents and furnishes food for the plants; how it equalizes the temperature of the soil during the growing season; how it carries soluble material down to the roots of the plants; how it prevents heaving and freezing out; how it increases the effects of manures; how it prevents rust in wheat, rot in potatoes and other like diseases; how it improves the quality and quantity of crops. But I would earnestly commend this matter to your attention. If the statements made of the value are correct, then it would pay to hire money, if necessary, to pay for the work, and most certainly if a farmer has money loaned out at eight or ten per cent. interest he had better call it in, and spend it "burying crockery in the ground."

If there is any doubt of the efficacy of draining, why cannot a neighborhood of farmers club together and unite in draining, say a ten-acre field of one of the number, he agreeing to pay the cost if the work proved successful, otherwise all to share it equally?

If the State Board of Agriculture succeed in having the proposed trial of power ditching machines at the College Farm, the farmers of the State will be shown what can be done with machinery in this line. If the State Board can, by successful trial, show that machines will do this work cheaply and well, the money spent will be returned to the State a thousand-fold.

The *Rural World* has long been an earnest advocate of tile draining in the West, and if it has or can induce any to undertake the work, our labors will not have been in vain.

PRACTICAL DRAINAGE.

Read at a Farmers' Institute meeting held at Maryville, Nodaway County, Mo., by T. W. Gaunt, Esq., of Maryville.

All understand that this meeting is called in the interest of the husbandman. We realize the importance of their mission. They by patient toil and industry bring out of nature's storehouse the enormous yield of grain, fruits and vegetables, that are gathered annually. To them under the blessing of the Infinite, the great republic is indebted for its daily bread. By the inventive genius of the great workshops of America, they have been materially aided in their work of cultivation and harvesting the fruits of their toil with comparative ease. We are living in a fast, progressive age. The days of the sickle and scythe have given way for the most approved reapers and mowers. The old plow with its wooden moulboard is laid aside for the best steel plow. Improved cultivators and many other useful implements are used throughout the great west for the cultivation and preparation of the soil so that the earth may yield an abundance in return. Happily in Northwest Missouri we have an excellent soil, unsurpassed in its fertility. The high ridge land is best adapted for the culture of all kinds of grain, fruits and vegetables. The sub-stratum is a joint clay, through which the water can percolate to an indefinite depth, and is discharged at the surface by springs, and may be regarded as the outlets of a natural underground drainage. In a retentive clay or in hardpan districts artificial drainage should be done on an extensive scale. The water then could never stagnate, that is, never exceed the point of saturation, and on this soil the crops are secure from the extremes of drouth or drowning. The rivers of a country with their tributary streamlets are the natural channels for removing the rainwater from its surface. However much remains to

be accomplished by human labor and ingenuity in draining the soil and subsoil from stagnant water by means of artificial underground channels. Our river bottom lands by a thorough system of underdraining can be made to yield double the quantity of corn they now produce. Another important consideration in connection is the improved condition of the health of the people. Instead of so much stagnant water to be evaporated by the sun's rays it would pass down to the artificial drain and become a living stream, thus the surface would be relieved of its stagnant water, and health and wealth are brought to these hitherto unhealthy locations.

Many of our prairie farms, and especially the hillsides and sloughs, need draining. The sub-stratum of many of our prairie hillsides are a retentive clay that will not allow the downward passage of water, places fit only for the primitive growth of rushes, wiregrass, sloughgrass and mosses. There are many acres of land that are surcharged with water that is run over every year, that does not produce enough to pay the taxes on it. The most effectual way to secure a crop from drowning or parching, is to put the land in a right condition with respect to drainage. Underground drainage is the only remedy we have to offer for all waterloged soils. An excess of water in the soil keeps down its temperature and retards the growth and maturity of any crop that may be planted. Water when present in soil in excess and in a stagnant state is constantly carrying off the heat that is obtained from the sun's rays by evaporation, and radiation. It is unprofitable for the farmer with means, to allow this condition of soil to remain any longer. The beneficial effects of thorough draining are soon apparent, for the increase in produce will soon pay all expenses. Plowing, planting and cultivating are begun earlier than before in consequence of a drier and more friable condition of the soil, and becomes as productive as the best ridge land. We have a piece of land that was too wet to raise good corn. After draining in a thorough manner we planted it in nursery stock, which is now in a fine, thrifty condition; the soil now is as easy of culture as the finest soil we have. We think that if whole neighborhoods, by mutual agreement, were to assist each other in this good work of improving their farms, it would be the best way to do the work, which in the end would prove highly beneficial to all. The water obtained from the drains can be utilized in that of filling large ponds or reservoirs with water for the double purpose of supplying an abundance of water for stock and for the culture of fish, especially the German carp that thrive so well in water that is obtained from the drains. Our main drains are about four feet deep, with lateral or side drains graded back from the main drain to

three feet, and averaging forty to forty-five feet apart. The result is all that could be desired; they do their work of draining in a very satisfactory manner. We do not set the above distances down as a general rule; this would depend on the porosity of the sub-strata, while many drains would do fifty to fifty-five feet apart; thirty feet in some very wet localities would be far enough apart. We would add a word of caution, that is, in laying drains; if there is any kind of growth, such as willow, cottonwood or anything like brush growing along the line of drain, it should be taken out by the roots, for if allowed to grow the fine rootlets will enter the drain through the joints and in time will fill the inside of the tiles so as to stop the passage of the water. We have a little experience of this. We did without a second thought lay a drain too near some basket willows, and in a little over two years our drain stopped working; the water rose to the surface and ran off in quite a stream. On examining the drain by the willow bushes we found that the drain was completely stopped by a very compact mass of thread-like roots that had penetrated the drain through the joints of the tiles. However, when a drain must of necessity pass near to trees or shrubs, it can only be saved by the intrusion of roots by laying the tiles in cement and covering the joints with a thick coat of the same. In laying tiles it is necessary that a fall of three-sixteenths of an inch to every two feet of drain be had if possible; the natural fall will sometimes give more. The only way for the tiles to clear themselves of silt is to have a good fall. We bed the tiles down in a groove cut with a tile hoe and grade with a spirit level. We use tiles of four-inch inside diameter for the main drains of eighty rods long, but drains longer than this, five or six-inch inside diameter should be used. For lateral or side drains we use three inch inside diameter. The cost of digging, laying and filling a drain of three feet deep should not exceed thirty-five cents per rod. A drain four feet deep should not cost to exceed forty-five cents per rod, and if dug deeper, at the same ratio. We are glad to know that many of our citizens in different parts of the county have been quite as successful in draining as we have been; some are well supplied with stock water and some of the ponds are well stocked with fish; two or three crops of ice may be cut during the winter of the finest quality and stored away for summer use. To recapitulate, we have by the industry of underground draining a drier soil, a purer atmosphere, an excellent crop where little or no crop was obtained before, an abundance of good water for stock, a good supply of fresh fish and the finest quality of ice. This does pay.

UNDERDRAINING.

A paper read before the Farmers' Meeting at Laddonia, Audrain County, Missouri, by J. L. Erwin, of Fulton, Missouri.

Perhaps less is understood by the mass of farmers to-day in Missouri on the question of underdrainage than any other topic connected with improved agriculture.

The puzzling question is how the water gets into the tile. I answer on the same principle as the water goes through the ashes in an ash-hopper. It is open at the bottom. The pressure of the water forces itself down through the ashes and out at every little crevice below. Every housewife knows that if there is the least crack in the trough the lye will find it and escape. Soils, as a rule, are as porous as the ashes. The little cracks at each joint of drain-tile admit the water from above if there is more than ought to be held by absorbtion for the growth of vegetation, or if the water rises from below as from springs or spongy places when it reaches the tile it flows off instead of coming to the surface.

A drained soil retains a great deal more moisture in a dry time than an undrained. The underdrained soil has, by the action of the winds, the weight of the water, the effort to cultivate, the treading of stock, had its particles pressed together so that they adhere, and as the water dries out by evaporation, great cracks are formed, admitting air and sunshine; these cracks break the roots of the plants which gather up the nourishment, and the plant starves or burns. In a drained soil the particles do not adhere but simply rest against each other, forming millions of little spaces and tubes that the water rises through from below, by what is called capillary attraction. Did you ever notice a woman wipe a floor when scrubbing? She always wets the cloth before beginning. When it is damp the water below or on the

floor has a greater affinity for it, and it is readily absorbed, whereas, if it is dry, absorption is very slow. In a drained soil the damp soil above continues to absorb the water from below, bringing it to the roots of the plants, dissolving the matter in the soil so that it may be taken up by the plant. The drained soil is loose and mellow, the undrained is hard and in great clods, if broken or stirred when dry, and in no more fit condition for plant growth than if it were so many rocks. It very frequently happens that a piece of land naturally dry enough for all practical purposes is kept wet by a supply of water from some other point. We have all noticed that after a pond is made, when it fills with water the ground becomes wet and spongy below it. It matters not how dry it was before. Our first efforts at drainage should be to take charge of the water from the wet weather springs or spongy places, as they not only wet the ground to the point of saturation, but the surplus flows, as I before stated, to ground that would be naturally dry enough for cultivation.

The water that makes these wet weather springs usually falls on higher ground, sinks to a hidden sand bed and flows out through it. In towns one man's lot may be made wet by the well of some one who resides on higher ground. A still greater danger is that it may pass by the privy or other place where refuse is deposited, and find its way into the well of a neighbor who resides on lower ground. The intelligent physician now looks to the surroundings for the cause of such diseases as typhoid or slow fever, diphtheria, etc.—excuse the digression. Having determined the source of supply, the next question is how to take care of it. There is one truth that must ever be borne in mind, which is that "water always runs down hill." You cannot carry it along a hillside without its coming out on a level below the drain. The drains, to be successful, must always be laid in the direction the water will naturally flow. Usually the wet or supply places are at the head and along the sides of hollows or slight depressions worn by the water.

It is now very common, and thought to be the best practice, to carry two lines of tile, one on each side of a hollow instead of one in the center. The danger from washout by surface water is so much less during a heavy rainfall. Having determined where you want to drain, the next question is the tile. I am using 2½, 3 and 4 inch tiles; 2½ inch by the car load, delivered at nearest station in Callaway county, will cost from $12.50 to $16.50 per thousand feet; the 3 inch from $15 to $20 per thousand feet; the 4 inch, from $18 to $25 per thousand feet.

The tile should be purchased and hauled to a convenient point for distribution before beginning the ditch. It ought never to be hauled

along the line of the ditch till after it is dug, as it is almost sure to get mud or dirt in it. In laying a mile of tiling I use about 3,000 feet of two and one-half, 2,000 feet three, and balance four inches, costing on the ground at Fulton about $100. I always outline my drains when the ground is very wet and drive down and mark stakes where I want the main drain and branches, to guide the party digging the ditch. I have found a small rope from 66 to 85 feet long makes a good line to cut the ditch by; stretch this tight along the line you wish the ditch. You now want the lightest, sharpest and brightest spade you can get, and you want to keep it so. Cut along the line, and then 8 to 10 inches from this cut a parallel line. Now you are ready to throw out the first foot. This you do with the same spade. The next 18 inches you use a spade 16 to 18 inches long, 3 to 5 inches wide at the point, to suit the size of the tile you wish to lay. You then fit the bottom for the tile by using a drag scoop the size of the tile you wish to lay. In practice you dig 3 or 4 feet with the long spade. Then scrape the bottom carefully so as to get a uniform surface just the size of the tile and a uniform fall. This can be done best and most rapidly when there is water in the ground. The water will show you all the irregularities. Wherever you must make a bend make it gradual. By setting the tile on end and striking square against the end with a light hammer you can soon chip the end into any shape you wish without injuring the tile. I never use the factory-made T or L, as I can make connections or turns so much cheaper out of the straight pipe. Never strike on the side or you will split and destroy the tile. In laying use a straight fork handle with a socket hammer with a point about eight inches long, turned off square or at right angles with the handle; use in laying the tile the hammer or back you use in chipping the tile, knocking off little lumps, etc. Put the tile in same day you cut the ditch as far as you finish, being careful to turn, so as to secure the best joint the tile will make. Then cover and tramp in 5 or 6 inches of moist clay or soil, having first carefully covered all the holes, if any, with a piece of inverted sod. On 4-inch tile I use old hay, straw or cane bagasse for a covering. If there is any point where during a heavy rainfall the surface water must pass over the tile, the clay must be thoroughly rammed from the bottom to top to prevent the surface water getting in at this point and filling the tile with sediment. If the surface is free of stumps a drag made of a plank 3 by 12 and 12 feet long, with pieces mortised in 2 feet long and 2 inches from bottom edge, and plank bolted on for a platform for drivers to ride on. If the front plank is shod with plough steel in bar 4½ or 5 inches wide, the holes drilled in the center so that when it wears, rounding in front, it may be turned over, this will be found to make one of the most

valuable farm tools for not only filling ditch, but for leveling the ground. I use it in leveling up the road. It is driven with the front team a length ahead of the rear team in filling ditches, dead furrows leveling up the road, etc. The drivers stand forward if they wish to cut deep, on rear of platform if shallow. It makes no difference which team goes front, as you can go up one side of road and down or back on the other, or on the same side, as you may wish. Excuse the digression again. The distance apart I would put the drains would depend entirely on the nature and character of the soil. I would put enough tile in and around every spongy place, when the water rises, to gather all the water that may rise at this point, and then one or two tiles leading away, depending on the nature of the ground and the danger of washout during a heavy rainstorm. Too much care cannot be exercised at this point in finding the source of supply. The kind of weeds and bushes, if any, that grow at these wet places want to be noted, as they are different from what grows on dryer ground. Many a dollar may be saved by close observation at this point. The day will possibly come when it will pay to tile whole sections of land, but I think not now. It is the part where we receive the least certain reward for our labor on account of surplus water that we want to make equal to the best.

LIFE AND LABORS

OF

LOUIS PASTEUR

A PAPER PREPARED FOR A FARMERS' INSTITUTE AT MARSHALL, MO., DEC., 1885, AND SUBSEQUENTLY READ BEFORE THE AMERICAN MEDICAL ASSOCIATION AT ST. LOUIS, MO., MAY, 1886,

BY

SAMUEL SPAHR LAWS, A. M., M. D., LL. D.,
President of the Missouri University.

"*In the present state of science, spontaneous disease has no more existence than spontaneous generation.*"—Life of Pasteur.

LIFE AND LABORS

OF

LOUIS PASTEUR.

Louis Pasteur is a Frenchman. His father was at first a soldier, and after having served his country with valor, attested by decorations on the battle-field, he settled down to the trade of a tanner. As to Louis, his humble parents resolved and were accustomed to say: "We will make of him an educated man." The education of a boy is a good thing, but it does not necessarily lead to, nor away from his father's vocation. They sent Louis to school, first as a half pay scholar, and when the poor boy was somewhat advanced in his studies, he practiced relf-reliance by earning something in a somewhat menial way at his school. Little did these humble parents imagine that the time would come when their little house would be decorated with a plate having these letters on it in gold:

HERE WAS BORN LOUIS PASTEUR,
Dec. 27, 1822.

Little did they dream that that son, in the midst of a triumphal procession, and crowned with honors as a benefactor of his age, would pause before that cottage, thus decorated, and busrt into tears as he remembered their affection, devotion, and sacrifice in his behalf.

Pasteur is now in his sixty-fourth year; and for seventeen years he has suffered from paralysis. A newspaper correspondent thus describes Mr. Pasteur, in a letter dated Paris, Dec. 7, 1885:

"The young man at once took my card to M. Pasteur, and in a few moments returned in company with the famous chemist. M. Pasteur is a short, thick-set man, active and quick in his movements, with a large head and very determined expression, both in the eyes and mouth. His eyebrows turn up into sharp points, giving him something of the appearance of the alchemist as described in Sir Walter Scott's novels. He wore a small black silk smoking cap on one side of the head and a sort of dark blue reefing jacket, in the button hole of which was the Legion d'Honneur."

It looks very much as if we should have to take *cum grano salis*—with a grain of salt—the statement that he is "active and quick in his movements." He conducts his work through assistants, whom he directs and supervises. His paralysis was caused by personal exposure in prosecuting his scientific labors in rescuing the silk worm from its deadly parasites, and restoring to France, not to speak of other countries, the silk industry, with an annual revenue of thirty million dollars. He brought it to a more healthy and profitable condition than it had ever before enjoyed, after having fallen into utter and seemingly hopeless ruin. Notwithstanding this personal affliction, such is still his indomitable perseverance, and such his intellectual vigor and skill in directing the labors of assistants in his laboratory, that man and beast might fitly join in devout orisons for the prolongation of a life so precious, and the continuance of those useful labors, that have now been extended over a period of forty years. The hydrophobia sensation looks upon him as having acquired a wonderful and superficial notoriety by a chance shot, whereas it is but an incident in his long life of wonderful discovery.

Let me hasten to say that, at this time, I propose to notice very briefly and cursorily, and from a practical point of view, only a few of his labors. Of course, the student and scientist will go to the original memoirs of the Academy of Sciences and to his published works; and his recently published Life, which is virtually an autobiography, will not be neglected.

Prof. Tyndall, in his introduction to this book, says: "It is the record of extraordinary scientific ardor and success." And, also, that Pasteur's "labors have rendered him one of the most conspicuous scientific figures of this age." Indeed, it may be fairly questioned whether, when tested by the criteria of positive science and of usefulness, his solid and subtle discoveries and contributions to science do not have a homely value, surpassing those of any man of this century. Greatness is legitimately won only by service rendered, and thus judged, Pasteur's admirers may be excused for thus adjudging him first honors. M. Pasteur is a chemist. He is a member of the French

Academy of Sciences. He has held many important positions, has won many prizes and medals, and in recognition of his discoveries the French Government, 1874, granted him a pension of 20,000 francs a year.

His maiden exploit as a discoverer was made when a youth about twenty-four years of age. It was in the domain of molecular physics. The occasion of this exploit was the famous note commucated to the Academy of Sciences in these words:

"The paratartrate and the tartrate of soda and ammonia have the same chemical composition, the same crystalline form, the same angles, the same specific weight, the same double refraction, and consequently the same inclination of the optic axes. Dissolved in water, their refraction is the same. But while dissolved tartrate causes the plane of polarized light to rotate, the paratartrate exerts no such action. M. Biot has found this to be the case with the whole series of these two kinds of salts. Here the nature and the number of the atoms, their arrangement, and their distances apart, are the same in the two bodies."

This note calls attention to two well known bodies as "rigorously identical" in every empirical and describable particular, except that one acted on light in a manner different from the other. Scientists could find no explanation of this difference in the constitution of the two bodies; and the unsolved problem was formally and gravely laid before the French Academy by the distinguished Mitscherlich, a German chemist. Pasteur at once attacked this problem, and effected its perfect solution by showing that there is a tartrate with left-hand and another with right-hand rotation, the optically neutral salt arising from the union of the two. M. Biot rigidly confirmed this brilliant discovery of Pasteur, and when his report of this confirmation was made to the French Academy of Sciences, M. Arago, sharing the enthusiasm of the members, moved that the report "be inserted in the collected *memoirs* of the Academy"—an exceptional honor.

The details are too minute and too technical for our present use, but the importance and difficulty of the problem are sufficiently evident from the interest it excited and from the consequences of its solution.

When, afterwards, M. Biot presented Pasteur to Mitscherlich, with the remark, "My young friend, you may boast having done something great in having discovered what had escaped such a man as this," Mitscherlich replied with gravity and somewhat ungraciously, it seems to me, "I had studied with so much care and perseverance in their smallest details, the two salts which formed the subject of my note to the Academy, that if you have established what I was unable to discover, you must have been guided to your result by a pre-conceived idea." This seems rather stiff and indicative of wounded pride. How

different the behavior of these two veterans of science towards this youth! When Biot had perfectly verified the discovery, taking Pasteur by the arm, the illustrious old man said to him: "My dear child, I have loved science so well throughout my life that this makes my heart beat." Surely it was pardonable in this "dear child" that on making this startling discovery he was seized with a fit of enthusiasm, rushed from his laboratory, and, on meeting a colleague, threw his arms around him, exclaiming: "My dear Monsieur Bertrand, I have just made a great discovery, and I am so happy that a nervous tremulousness has taken possession of me, which prevents me from looking again through the polariscope. Let us go to the Luxembourg, and I will explain all to you." How human!

Is it strange that Cupid appeared upon the scene at about this juncture, and shot an arrow to the triumphant Parteur's very heart, that prostrated him at the feet of a fair maiden, who would receive it with a smile, when, in after life, reminded how he forgot his wedding day, so that it was necessary for a friend to go to his laboratory and remind him of it. The idea of a foung fellow being so absorbed in his laboratory as to forget his wedding day! Here is scientific enthusiasm.

Strangely enough, this first exploit of Pasteur in the seemingly remote and sterile domain of inorganized matter of molecular physics led by an easy transition to the two greatest discoveries of his life, and of this century, whose full unfolding, in the beneficial interest of man and animal, may require another century of luck and of ingenious and industrious labor. These two discoveries were: first, *the nature of fermentation;* and, second, *the transforming of the malignant virus* of zymodic diseases into benignant vaccine virus.

As to fermentation, Pasteur has overthrown the still popular and current doctrine of Justus V. Liebig, that it is a spontaneous chemical or semi-mechanical process. Let Liebig speak for himself. He says:

"By the terms *fermentation*, *putrefaction* and *eremacausis* are meant those changes in form and properties, which compound organic substances undergo, when separated from the organism, and exposed to the influence of water, and a certain temperature Fermentation and putrefaction are examples of that kind of decomposition, which we have named transformations; the elements of the bodies capable of undergoing these changes arrange themselves into new combinations, in which the constituents of water generally take a part.

"Eremacausis, or decay, differs from fermentation and putrefaction, inasmuch as it cannot take place without the access of air, the oxygen of which is absorbed by the decaying bodies. Hence, it is a process of slow combustion, in which heat is uniformly evolved, and occasionally even light. In the processes of decomposition, termed fermentation and putrefaction, gaseous products are very frequently formed, which are either inodorous, or possess a very offensive smell.

"The transformations of those matters which evolve gaseous products, *without odor*, are now, by pretty general consent, designated by the term *fermentation*; whilst the spontaneous decomposition of bodies which emit gases of a disagreable smell, the term putrefaction is applied. But the smell is, of course, no distinctive character of the nature of the decomposition, for both fermentation and putrefaction are processes of decomposition of a similar kind, the one of substances destitute of nitrogen, the other of substances which contain it.

"It has also been customary to distinguish from fermentation and putrefaction a particular class of transformations, viz.: those in which conversions and transpositions are effected without the evolution of gaseous products. But the conditions under which the products of the decomposition present themselves are purely accidental; there is, therefore, no reason for the distinction just mentioned."

Here we have, in Liebig's own words, his doctrine of fermentation as a chemical or semi-mechanical process. This extract is from "Liebig's Complete Works on Chemistry, the Part on Agriculture and Physiology," edited from the manuscript of the author, by Lyon Playfair, Ph. D., p. 90.

Liebig in another place says that fermentation "is the very reverse of the vital process," and all who had accepted and maintained this doctrine, misled by the mimicry of chemical processes, totally repudiated all vital action in fermentation as well as in contagious and infectious diseases.

On the other hand, Pasteur has firmly established the opposing doctrine, that fermentation or putrefication is probably in all cases due to the action of minute living organisms; and that the substances usually regarded as ferments are the food for these organisms; that fermentation is a process of nutrition.

The general name which it is proposed to give these minute beings is that of *microbes*, compounded of two Greek words *mikros*, little, and *bios*, living—little living things. They are indeed little. The name is good, as it implies no theory as to whether these little creatures are vegetable or animal, or neither, in their nature. "The problem, whether in a given case, an organism is an animal or plant, may be insoluble." Certain accomplished investigators and authors, in the domain of biology are quoted by Mr. Huxley, to the effect 'that they cannot express the excessive minuteness of the living granules in question; they estimate their diameter at less than 1-200,000 of an inch; *i. e.*, it would take more than 200,000 placed side by side to make an inch. Under the highest powers of the microscope, at present applicable, such specks are hardly discernible. Nevertheless, particles of this size are massive, when compared to physical molecules, each molecule being an aggregation of atoms, whence there is no reason to doubt that each microbe, small as it is, may have a molecular structure sufficiently complex to give rise to the phenomena of life. And, as a

matter of fact, by patient watching of the place at which these infinitesimal living particles were discharged, our observers assured themselves of their growth and development into new monads. These, the progeny, in about four hours from their being set free, had attained a sixth of the length of the parent, with the characteristic cilia, though at first they were quite motionless, and in four hours more they had attained the dimensions and exhibited all the activity of the adult. These inconceivable minute particles are, therefore, the germs of the monad, and from the dimensions of these germs it is easily shown that the body formed by conjugation, may at a low estimate, have given exit (existence) to thirty thousand of them; a result,' as Mr. Huxley remarks, 'of a matrimonial process whereby the contracting parties, without a metaphor, 'becoming one flesh,' enough to make a Malthusian despair of the future of the universe.'

These processes, according to the new doctrine, simply consist in the destruction or transformation of these compounds, and the formation of others by the action of these minute microscopic living organisms called microbes, whose multitudinous proliferations and voracious appetites beggar computation and description, because they defy conception. In these respects they are all alike, but they are quite diverse as to their modes of life and habits. The microbe that effects the production of lactic acid in soured milk differs from that of butyric acid in rancid butter, and both from that of yeast in bread, and so on.

Pasteur pressed his inquiry to the point of ascertaining that the free oxygen of the air is nescessary to some of these microbes, which are named for that reason, ærobies, and that it kills others, named anærobies; whereas that of yeast is amphibious, as it can live either with or without free air, but, strangely enough, when the air supplies oxygen to this yeast microbe, it is not a ferment, whilst it is one, when reduced to the necessity of appropriating or wresting its oxygen from a fixed state in some chemical compound.

A German manufacturer of pure chemicals was perplexed in his business by a mysterious and damaging fermentation of the commercial tartrate of lime, on being dissolved in water and exposed to summer heat. This case was brought to the attention of Pasteur, who demonstrated that the fermentation was due to a living organism that fed on the right-handed tartrate, and not on the left-handed tartrate, the very acids which he had discriminated in his primary discovery in response to the Mitscherlich note to the Academy. It required the searching analysis of light to detect the difference between these tartrates, and yet the appetite of the living germ of the common mould, *penicillium*

glaucum, was found to be equally discriminating. This has been pronounced a "most remarkable experiment," but its critical importance to Pasteur and the world consisted in the notable circumstance, that his discovery in the domain of molecular physics was the occasion of his now being brought face to face with the phenomena of fermentation as vital phenomena.

The new doctrine that fermentation is due to microbes, in short, is "simply a phenomenon of nutrition," served to explain the whole process of the manufacture of vinegar, which is an extensive industry in France. Vinegar, as the name indicates, is wine turned sour; but vinegar or acetic acid, has in it no alcohol. In the formation of vinegar the alcohol disappears and is replaced by acetic acid. The true and only ferment of vinegar is a little plant, a microscopic and microbic fungus or mould, and of all plants it is one of the simplest and most minute, and has been known from time immemorial under the name of mother of vinegar. This plant is a cryptogam and like larger vegetables feeds on its appropriate aliments.

When Pasteur's views were questioned, he boldly gave the challenge that, in the presence of the Academy he would undertake, in the space of twenty-four hours, to cover with this fungus, *mycoderma aceti*, a surface of vinous liquid as large as the hall in which they were assembled. Said he, "I would only have to sow in it the day before almost invisible particles of newly formed *mycoderma aceti*.

By his scientific aid, this industry of vinegar manufacture was relieved of its troubles and placed on an intelligent, secure, and profitable basis.

In like manner he pointed out the diseases of wine, due to microscopic vegetations, and provided the simple remedy. On the same theory, he in like manner attacked and remedied "the diseases of beer." On this theory, he manufactured sweet wine, and pointed out the conditions for making and keeping it sweet and free from fermentation.

After Claud Bernard's death, a series of experiments was found among his papers, aiming at a new method of vindicating the spontaneous generation of the musk or ferment of the grape. Certainly here was a formidable foeman, but Pasteur soon silenced this newly unmasked battery. Said he:

"I will start for the Jura. In the midst of my vineyard, which," he proudly added, "is ten metres (thirty-three feet) square, I will cover some stocks with an improvised frame. These stalks will go on living and bearing grapes, which will ripen. It is now July. At this time of year the germs of the cellules which form the ferment of the grape in the vats do not yet exist, either on the green grapes, on the bunches, or on the vine leaves. I will envelop the bunches of the stalks

that are underneath the frame with a layer of cotton-wool that has been raised to a temperature of 150 degrees C, so as to free it of all germs. This done, I will come back to Paris, with the keys of the frame in my pocket, not returning to the Jura until the vintage season, at the beginning of October. I predict to the Academy that the grapes wrapped in cotton wool under the frame, and which will have grown ripe, may be crushed in the open air, and that the juice coming from them will not undergo fermentation."

He did as he proposed and returned in October to the Jura, plucked several stalks, brought them to Paris with care, placed them on the table in the presence of the Academy, and M. Berthelot, the editor of Bernard's posthumous pamphlet, and his colleagues were invited to cut as many bunches as they pleased. "Only crush them in contact with pure air," said Pasteur, "and I defy you to produce fermentation." His prediction was fulfilled, and his triumph, as usual, was complete.

Pasteur is represented as being as reserved and timid as a child till his laboratory work has put him in possession of nature's truth, then he is as bold and fearless and may be as fierce as a lion in its defence. He has contended valiantly at home and abroad with men of great distinction, and with singular success for what he has conceived to be the truth. It is said of him that "no scientific man now living has fought so many battles as he." His views have won their way against skepticism and opposition. In one of these fierce scientific contests at the Academy of Medicine, a gentleman at the age of eighty, challenged him to mortal combat as a scientic ultimatum. His last antagonist is a noted political demagogue.

Prof. Huxley says: "I know not where we can hope to find any absolute distinction between animals and plants, except their mode of nutrition. * * * Thus we have a very wide basis of fact for the generalization that plants are essentially characterized by their manufacturing capacity—by their power of working up mere mineral matter into complex organic compounds."

Just as the lives of green plants and animals are distinguished by their different modes of feeding, so their diseases are, also, seemingly due, largely, to the difference in the modes of feeding by microbes or microscopic living organisms. There is, for example, a fungus, which is an obscure and microscopic mould, in structure as much a mould as mildew. This fungus is the cause of the potato disease, and brought about the Irish famine.

"Just as the common mould multiplies by the breaking up of its hyphæ, or filaments, into separte, rounded little bodies, the spores—so, certain of the filaments of this fungus grow out into the air, through the interstices of the superficial cells of the potato plant, and develop spores. Each of these filaments usually gives off several branches, the ends of the branches dilate and become closed sacs,

which eventually drop off as spores, *i. e.*, as minute, separate, rounded bodies. The spores falling on some part of the same potato plant, or carried by the wind to another, may at once germinate, throwing out tubular prolongations, which become filaments and burrow into the substance of the plant attacked. But more commonly, the contents of the spores divide into six or eight separate portions. The coat of the spore gives way and each portion then emerges as an independent organism, which has the shape of a bean, rather narrower at one end than the other, convex on one side, and depressed, or concave, on the opposite. From the depression, two long and delicate cilia proceed, one shorter than the other, and directed forwards. Close to the origin of these cilia, in the substance of the body, is a regularly pulsating, contractile vacuole. The shorter cilium vibrates actively and effects the locomotion of the organism, while the other trails behind; the whole body rolling on its axis with its pointed end forwards. The eminent botanist, DeBary, who was not thinking of our problem, tells us, in describing the movements of these zoospores, that, as they swim about, foreign bodies are carefully avoided and the whole movement has a deceptive likeness to the voluntary changes of place which are observed in microscopic animals.

"After swimming about in this way in the moisture on the surface of a leaf or stem (which, film though it may be, is an ocean to such a fish) for half an hour, more or less, the movement of the zoospore becomes slower and is limited to a slow turning upon its axis, without change of place. It then becomes quite quiet, the cilia disappear, it assumes a spherical form, and surrounds itself with a distinct though delicate membranous coat. A protuberance then grows out from one side of the sphere, and rapidly increasing in length, assumes the character of a hypha or filament. The latter penetrates into the substance of the potato plant, either by entering a stomata or by boring through the wall of an epidermic cell, and ramifies, as a mycelium, in the substance of the plant, destroying the tissues with which it comes in contact. As these processes of multiplication take place very rapidly, millions of spores are soon set free from a single infested plant; and from their minuteness, they are readily transported by the gentlest breeze.

"Since, again, the zoospores set free from each spore, in virtue of their powers of locomotion, swiftly disperse themselves over the surface, it is no wonder that the infection once started soon spreads from field to field and extends its ravages over a whole country."—Science and Culture, and Other Essays, by Huxley, pp. 175, 177.

From the plant world let us pass over to the animal world, and the interest of our search will be heightened. We shall there find increased and confirmatory evidence that the unity of nature, in her normal workings, is emulated by her unity in what, perhaps, our ignorance designates abnormal workings; that her unity in the normal physiology of plants and animals is rivaled by a discovered unity in her abnormal pathology. It may be stated that the diseases of animals appear to be largely, if not wholly, as really due to the normal life of parasites, as are the diseases of plants. In the present state of science, as illuminated by the genius of this age, it would seem that spontaneous disease may have no more existence in plant or animal than spontaneous generation.

Leaving now the potato patch, the vinegar, the beer and the wine vats, let us go to the chicken coop, to the fowl yard, to the sheep, to the hogs and to the cattle of the barn-yard, and then to the sick chamber of man, and we will find everywhere that what is the normal life of the microscopic parasite is the death of the gross animal organism. Just as the normal nutrition of the microbe destroys the life of the animal, which has for man food value, so the normal life of the mould (*peronospora infestans*), the microscopic potato parasite, is the death of the gross vegetable, which also has food value for man. Plants have eminently the power of feeding on inorganic elements as well as on organized food; a bean in water containing certain mineral salts in due proportion with air, sunlight and heat, will grow and produce a crop as if planted in the ground. But animals feed on organized food; and hence they either feed on plants or on other animals that feed on plants. Plants build up, animals tear down.

Recent discoveries are in the direction of establishing the fact that many of the most deadly diseases of animals are caused by the feeding of carnivorous microscopic parasites, vegetable or animal, upon their vital organs. Investigation tells us, as already remarked, that these minute organisms almost elude the highest powers of the microscope, being sometimes but specks almost infinitesimally small, even less than one two hundred thousandth of an inch in diameter. "Nevertheless," says Huxley, "particles of this size are massive when compared to physical molecules, whence there is no reason to doubt that each, small as it is, may have a molecular structure sufficiently complex to give rise to the phenomena of life. And, as a matter of fact, these infinitesimal living particles have been observed to grow and to develop into new monads or microbes."

In Europe and America, chickens are subject to "an exceedingly fatal contagious disease" that causes enormous losses. This disease is popularly known as "chicken cholera." This statement is substantially from the Report of United States Department of Agriculture, for 1881, on Contagious Diseases of Domestic Animals, page 27. This disease of chicken cholera is thus described:

"The bird, which is attacked by this disease, is without strength, staggering, its wings drooping, the ruffled feathers of the body give it the shape of a ball. An overpowering somnolence takes possession of it. If forced to open its eyes, it appears as if awakened out of a deep sleep. Very soon the eyelids close again, and generally death comes without the animal changing its place, or without any struggle, except at times a slight movement of the wings for a few seconds. The examination after death reveals considerable internal disorders."

This description will suggest to every physician cerebral affection.

Various professional parties had supposed that this disease was due to a microscopic organism or microbe, but it remained only a puzzling and unverified conjecture or suspicion till Pasteur took up the subject and unveiled its secret. So completely did he master the case, that he prescribed a simple and perfect remedy, that puts it in the power of every farmer to banish this pest from his barnyard. Here is the remedy:

"This very serious disease depopulates sometimes all the poultry yards in the country. The only means of arresting the contagion is to isolate for a few days only, the fowls and the chickens, to remove the dung heaps, to wash the yard thoroughly, especially with water acidulated with a little sulphuric acid, or carbolized water with two grammes of acid to the litre. These liquids readily destroy the microbe, or, at least, suspend its development. Thus all causes of contagion disappear, because, during their isolation, the animals already smitten die. The action of the disease, in fact, is very rapid."

But there were two things connected with the conquest of this case that claim our special attention, on account of their radical importance; one was the method of identifying and individualizing the chicken cholera microbe, and the other was the conversion of the malignant into a benignant microbe, taming, or domesticating it. Pasteur took what was supposed to be the deadly microbe from the fowl, and devised a way of cultivating it in an artificial medium. An infusion of the muscle of the chicken was found most favorable. By sterilising this infusion with potash and heat, and then putting into it this microbe, thus freed from mixture or confusion with other organisms, in a few hours the clear infusion began to grow turbid from the new birth of microbes, and a fowl inoculated with the thousandth part of a drop of it was seized by the disease and died.

By passing from one prepared infusion to another, and simply transferring the least possible quantity, only so much of the last fluid as the point of a needle would carry, the new proliferation would in like manner be shown by turbidness, and after a thousand successive cultivations its malignity would not be lessened or altered. The fact that the last in these successive steps of reproduction produced by inoculation of the same minute quantity, the same disease and death as the first parental organisms in the series, certainly identified the microbe as the true and sole author of the disease. But it was, curiously enough, noticed that between no two of these successive cultivations must more than twenty-four hours intervene, or the virulence would be modified. This fact was full of meaning. This modification or attenuation of the contagium, or virus, generally corresponded with the duration of the interval. If any number of birds were inoculated from any given

culture or crop of microbes, within twenty-four hours after its production, a hundred per cent. of them would die; whereas, if the culture were allowed to remain three months hermetically sealed, or only exposed to pure air, then its inoculation would cause some illness in the fowls operated on, but not a death would occur, and in a few days all would recover their appetites and spirits. And now, to complete the proof, it was found that, if, after this recovery, the fowls were inoculated with the fresh, deadly virus, it would occasion some illness, but no death.

Here, then, is a poisonous microbe, a virulent microscopic parasite, a living organism, *cultivated in the laboratory, outside of the body of any animal*, and, by a very simple mode of handling, converted into its own antidote. The malignant virus, in a word, is rendered benignant. Moreover, this benignant or attenuated virus may be cultivated without reverson to its malignity, or it may be made to revert. Its mitigated and mild nature may be caused to remain unchanged, however, and then it retains its beneficent power of protecting against the assaults and ravages of its own kind in their original and savage state. Their deadly fangs are extracted.

The intimate process in nature's laboratory by which this modification in any given microbe is effected, may not be fully understood, but the fact is brought to light and placed under the control of man's will and intelligence; and this is the new and important vantage ground from which the battle of life in the future will be waged, at least against all virulent and non-recurrent diseases caused by discovered microscopic organisms. Already the keen discrimination of many observers has individualized the microbes of different animal diseases, as well as of various vegetable diseases. It had already been shown, before this discovery of the attenuation of the chicken cholera microbes was accomplished, that the microbes of splenic fever and septicæmia were specifically distinct from each other, and, also, that each differs from that of fowl cholera; other microbes have been individualized in other diseases, and the list is increasing; great diligence is aroused in this field of inquiry. Is it unreasonable to anticipate the time when glanders, diptheria, the plague of the east, yellow fever, scarlatina, measles, camp typhus, leprosy, and other infectious and specific diseases will be as subject to human control as small-pox, to which chicken cholera, hog cholera, splenic fever, tuberculosis, hydrophobia, and a few others are already being added? Dr. W. A. Hardaway, of St. Louis, in his excellent little work on vaccination, remarks that "the researches of Pasteur on the attenuation of viruses lends the strongest scientific support to the results of clinical experience. The time may even arrive," says he, "when the inoculation of attenuated variola virus will supercede altogether the use of vaccine lymph." That is to

say, vaccination for small-pox, as practiced by Jenner, and ever since, in all its variations by its transference from animal to animal, is not scientific, but merely empirical, its microbe never having been indi vidualized and cultivated outside of the animal body, and the conjecture is here indulged that Pasteur's method of scientific vaccination for small-pox may yet supercede our present empirical practice. It is due to this empiricism that the present unfortunate and insuperable difficulties and uncertainties are attendant upon the procurement of virus perfectly pure, and of standard vigor. It is manifest that this discovery of Pasteur transcends that of Jenner, and will probably serve to perfect what was, with Jenner, a chance observation, which has hitherto received no true scientific development.

Said M. Bouley, on the day when Pasteur announced his discovery of cultivating and modifying a virus in the laboratory, to the Academy of Sciences:

"A new doctrine opens itself in medicine, and this doctrine appears to me powerful and luminous. A great future is preparing: I wait for it with the confidence of a believer, and with the zeal of an enthusiast."

Pasteur is not a physician, but a chemist and scientist, and the medical world has already shown some appreciation of his work. A brilliant spectacle was witnessed in London five years ago, August, 1881, illustrative of this remark, when three thousand Doctors of Medicine, from all parts of the civilized world, convened in an International Congress, received Pasteur with marks of honor and enthusiasm. He used in response to their complimentary address the following significant language:

"I have lent to the expression 'vaccination' an extension that I hope science will consecrate as a homage to the merit and immense services rendered to humanity by one of the greatest men of England—Jenner."

He thus modestly points out how his great discovery in attenuating a virus has raised vaccination from the dull round of empiricism to the luminous sphere of a science—from an individual case, treated by rule of thumb, to an intelligent principle and a method applicable to all like cases—but this anticipates.

The virus of chicken cholera had been controlled, but was it possible to control the virus of other deadly diseases? The answer is at hand. This was vital. In 1879, the Minister of Agriculture in France appointed M. Pasteur to test the value of a mode of treatment recommended by a veterinary surgeon for cows affected with splenic fever.

Pasteur soon demonstrated its inefficiency by noting on trial, that as large a percentage recovered without the treatment as with it. It was some merit, perhaps, that the treament made the cases no worse. But in making this test he also noted that some cows, once sick of this fever and near death, when after recovery, freely inoculated with the malignant virus, were entirely proof against the disease. His next step was to render, also, this virus benign, as he had done that of chicken cholera. But the two parasites are of different forms, and are unlike in their modes of propagation, the proliferation of one being by fission and of the other by spores; could these unlike germs be alike controlled or mitigated? When engrossed with this new problem, Pasteur was heard to exclaim, in soliloquy: "Ah! what a grand thing it would be if one could arrive at that—if the fact that the attenuation of the microbe of fowl cholera proved not to be an isolated one!" For a time he was much absorbed and very reticent. At last, one day, he came to his house with a radiant face and tears in his eyes; having, Frenchman like, embraced the members of his family, he said: "I should never have consoled myself if a discovery, such as my assistants and I have just made, were not a French discovery." His patriotism inspired him, and he had come to realize that his labors as a scientist involved the glory of his beloved France.

February 28, 1881, in his fifty-ninth year, thirteen years after his stroke of paralysis, and the second year after entering on the investigation by government appointment, he communicated to the Academy of Sciences, in his own name, and in the names of his assistants, his great discovery that the deadly splenic fever virus could be cultivated in the laboratory, outside of the animal body, and mitigated into a prophylactic vaccine virus. To his honor be it said, Pasteur has never ignored his coadjutors, young or old. Soon after this report was published, the president of the Agricultural Society in Melun, Le Baron de la Rochette, visited Paris and invited him to test before the society, and on a grand scale, his "splenic fever vaccination." The society agreed to place at his disposal sixty sheep and ten cows; ten sheep were to receive no treatment; twenty-five were to be vaccinated with attenuated virus, and, after a certain interval, to be inoculated with malignant virus; and, also, at the same time, and with the same malignant virus, were to be inoculated twenty-five sheep that had not been vaccinated with the benignant virus. Six cows were to be vaccinated and four were not to be vaccinated; and the ten cows were then, after an interval, to be alike inoculated with the same malignant virus, and on the same day as the sheep. Pasteur predicted—and this is one of the truest and severest tests of a discovery in nature—that, when the animals were inoculated with the malignant virus, the un-

vaccinated sheep would die, and that the vaccinated ones would resist this malignant virus; also, that the six vaccinated cows would resist, and that the unvaccinated ones, if they did not die, would be extremely ill—the natural system of cattle being more resistant to this fever than that of sheep. When it was published in scientific and agricultural circles that M. Pasteur had engaged to carry out this programme, it caused a commotion. Several of his colleagues in the Academy of Sciences, we are told, remonstrated with him, lest they should be compromised by his rashness and failure. But his faith in the soundness of his laboratory work inspired him with the courage to say: "I have full confidence." And one of his colleagues, M. Bouley, responded to his anxious associates: "Fear nothing; he will come back triumphant."

Well, May 5, 1881, on a farm belonging to a veterinary doctor, who was secretary general of the agricultural society, the experiment was entered upon by vaccinating twenty-four sheep and a goat (by consent substituted for a sheep), and six cows, each with five drops of attenuated virus. Twelve days later, the thirty-one animals were re-vaccinated with virus somewhat less benignant. May 31, or after an interval of fourteen days following the second vaccination, the thirty-one vaccinated animals stood side by side with the unvaccinated, and all were then inoculated with the same malignant virus. The vaccinated and unvaccinated were inoculated alternately. The crowd then adjourned to meet June 2, the second day afterwards, and more than two hundred persons of all classes were then assembled to witness the result; among them were farmers, senators, journalists, veterinarians, doctors and counsellors. Those who believed, and doubters, came.

On their arrival at the farm of Pouilly-le-Fort, they could not repress a shout of admiration. Out of the *twenty-five sheep* which had *not* been *vaccinated*, twenty-one were dead; the goat was also dead; two other sheep were dying, and the last, already smitten, was certain to die that very evening. The *non-vaccinated cows* had all voluminous swellings at the point of inoculation, behind the shoulder. The fever was intense, and they had no longer strength to eat. The vaccinated sheep were in full health and gaiety. The vaccinated cows showed no tumor; they had not even suffered an elevation of temperature, and they continued to eat quietly.

There was a burst of enthusiasm at these truly marvelous results. The veterinary surgeons especially, who received with entire incredulity the anticipations recorded in the programme of the experiments, and who, in their conversations and in their journals, had declared very loudly that it was difficult to believe in the *possibility* of preparing vaccine capable of triumphing over such deadly diseases as fowl

cholera and splenic fever, could not recover from their surprise. They examined the dead, they felt the living.

"Well," said M. Bouley to one of them, "are you convinced? There remains nothing for you to do but to bow to the master," he added, pointing to Pasteur, "and to exclaim—

I see, I know, I believe. I am undeceived."

Having suddenly become fervent apostles of the new doctrine, the veterinary surgeons went about proclaiming everywhere what they had seen. One of those who had been the most sceptical carried his proselytising zeal to such a point that he wished to inoculate himself. He did so with the two first vaccines, without other accident than a slight fever. It required all the efforts of his family to prevent him from inoculating himself with the most virulent virus.

An extraordinary movement was everywhere produced in favor of vaccination. A great number of agricultural societies wished to repeat the celebrated experiment of Pouilly-le-Fort. The breeders of cattle overwhelmed Pasteur with applications for vaccine. Pasteur was obliged to start a small manufactory for the preparation of these vaccines in the Rue Vauquelin, a few paces from his laboratory. At the end of the year 1881, he had already vaccinated 33,946 animals. This number was composed of 32,550 sheep, 1,254 oxen, 142 horses. In 1882 the number of animals vaccinated amounted to 399,102, which included 47,000 oxen and 2,000 horses. In 1883, 100,000 animals were added to the total of 1882, making 500,000.

It is reported that to the extent that this new system has been practiced among flocks and herds, the mortality from splenic fever has been reduced from ten to fourteen times less. But this disease is "common both to men and animals," it being known in the former as "malignant pustule," and is usually found in those whose business in some way brings them into contact with domestic animals, and who are in any way exposed, from a slight abrasion or scratch of the skin, or the sting of a fly, to an invasion by the deadly splenic microbe.

There is, then, a human side to this story, and in that, after all, our chief interest centers, but it cannot be estimated in dollars and cents. As far back as 1862, in his memoir on spontaneous generation, Pasteur had applied his new doctrine of fermentation to ammoniacal urine and found that its alteration was due to the presence and action of a little microscopic fungus, not to pus, nor to some morbific force inherent in the excess of mucous secreted from distension which chemically attacks the urea. A representative of the profession, Dr. Traube, put this microbe view to the test, and concluded on his facts that "not-

withstanding the long retention of the urine, its alkaline fermentation begins only when the germs of vibrios find access to the bladder from without." Dr. Guyon, clinical professor of urinary diseases in the Faculty of Paris, in one of his lectures, credited Pasteur with the honor of this discovery and satisfactorily applied microbicide remedies. These cases are mentioned here as items in a record. Dr. Lister, whose name is honorably associated with antiseptic surgery the world over, began his special labors in Edinburgh in 1865, and in 1874 wrote to Pasteur as follows, to wit:

"It gives me pleasure to think that you will read with some interest what I have written about an organism which you were the first to study in your memoir on lactic fermentation. I do not know whether you read the *British 'Medical Journal;'* if so, you will, from time to time, have seen accounts of the antiseptic system, which, for the last nine years, I have been trying to bring to perfection. Allow me this opportunity of sending you my most cordial thanks *for having, by your brilliant researches, demonstrated to me the truth of the germ theory of putrefaction, thus giving me the only principle which could lead to a happy end, the antiseptic system.*"

Prof. Tyndall acquired not a little distinction by his inquiries respecting spontaneous generation and microscopic germs. Our natural curiosity to know whence came his inspiration, is gratified by the following acknowledgment and tribute. In 1876, Prof. Tyndall wrote to to Pasteur, thus:

"In taking up your researches relating to infusorial organisms, I have had occasion to refresh my memory of your labors; they have revived in me all the admiration which I felt on first reading them. *It is my intention to follow up these researches until I shall have dissipated every doubt that has been raised as to the unassailable exactitude of your conclusions.*

Prof. Tyndall, describing his own experiments, says, "the experiments have already extended to 105 instances, not one of which shows the least countenance to the doctrine of spontaneous generation." Nature, Vol. XV., p. 303. Dec. 21, 1876.

"For the first time in the history of science we are enabled to entertain the sure and certain hope that, in relation to epidemic diseases, medicine will soon be delivered from empiricism, and placed upon a real scientific basis. When this great day shall come, humanity will recognize that it is to you the greatest part of its gratitude is due."

These special labors of Tyndall, the physicist, and of Lister, the surgeon, were, therefore, confessedly based on the labors of Pasteur, the chemist.

At the International Medical Congress in London, 1881, to which reference has been made, a member who practices in one of the principal hospitals of that city, conceded that there were parasitic diseases, but expressed it as his opinion that "the microbes are the effect and not the cause of these diseases." Pastuer, who was present, at once took up the gauntlet, expressed his amazement that "such a scientific heresy" should be held at that day, and then challenged this member to a test of the opposing views, in these words: "Take the limb of an animal and crush it in a mortar, let there be diffused in this limb, around these crushed bones, as much blood or any other normal or abnormal liquor as you please. Take care only that the skin of the limb is neither torn nor laid open, and I defy you to exhibit on the following day or during all the time the malady lasts, the least microscopic organism in the humors of this limb." The challenge thus promptly, openly, and defiantly made, was declined. However, this member's advocacy of spontaneous generation had previously suffered a terrible overthrow by England's most distinguished biologist.

It is now six years since M. Pasteur began to wrestle with hydrophobia, another of the diseases common to man and animal. Soon after a microbe virus was discovered in the saliva of a rabic victim, which was easily cultivable, but it failed to establish its exclusive claim as the specific cause of the disease. Instead of saliva being used, it was at last found most effective to inoculate into the circulation by a vein, the nervous matter of a rabic animal. Usually, the brain pulp is used, and the mitigation is affected by its passage through certain living organisms as was discovered to be practicable with the hog cholera microbe. The rabies' microbe is as yet conjectural, as it has not been isolated so as to certainly secure its cultivation outside of the animal organism. Hence, this particular case has not yet been brought fully up to the scientific standard. Yet, public impatience has forced a practice which has lost only about one per cent. out of over six hundred cases, and, certainly, with such a practical record, the theoretic aspect is about as hopeful as that of small-pox. It will require much time to mature and perfect the methods so auspiciously and brilliantly inaugurated.

The publication of the French Acadamy, Jan. 24, 1887, gives the number of cases of hydrophobia, including those from wolf-bites, up to Dec. 31, 1886, treated at the Institute of Pasteur in Paris, 2,682, of whom 31 died, *i. e.*, about one per cent. It is stated that previous to Pasteur's treatment, the most favorable statistics show about 16 per cent. of deaths. However, the treatment of hydrophobia, like that of small-pox, is still empirical, and involved in controversy.

In 1872, Dr. Lionel S. Beale published his work on Disease Germs, and his exposition and defense of the germ theory of disease had an important influence on the medical profession, and on current views as to the nature of disease. It enrolled some of the sturdiest of the profession. In that work, Dr. Beale uses this language: "That the several kinds of contagious matter of small-pox, scarlet fever, and other eminently contagious maladies, are distinct, each being imbued with its own specific and peculiar power, is demonstrated by observation, but that this difference in power or property should be associated with any recognizable difference in appearance, form, chemical composition, or any physical characters, is exactly what a careful examination of the facts, and a judicial weighing of the evidence, would not lead us to anticipate." By Pasteur's method, as we have seen, is accomplished, already, and to a considerable extent, exactly what, according to this high authority, was not to be anticipated.

Some germs are sensibly distinguishable. In speaking of the protective action of attenuated virus or vaccine microbes, Prof. Tyndall unfolds Pasteur's idea of it under the garb of farming, thus: "When a tree or a bundle of wheat or barley straw is burnt, a certain amount of mineral matter remains in the ashes—extremely small in comparison with the bulk of the tree or of the straw, but absolutely essential to its growth. In a soil lacking or exhausted of the necessary mineral constituents, the tree cannot live, the crop cannot grow. Now contagia are living things, which demand certain elements of life just as inexorably as trees, or wheat, or barley; and it is not difficult to see that a crop of a given parasite may so far use up a constituent existing in small quantities in the body, but essential to the growth of a parasite, as to render the body unfit for the production of a second crop. The soil is exhausted, and, until the lost constituent is restored, the body is protected from any further attack of the same disorder. Such an explanation of non-recurrent diseases naturally presents itself to a thorough believer in the germ theory.

"To exhaust a soil, however, a parasite less vigorous and destructive than the really virulent one may suffice; and if, after having by means of a feebler organism exhausted the soil, without fatal result, the most highly virulent parasite be introduced into the system, it will prove powerless. This, in the language of the germ theory, is the whole secret of vaccination. This problem," he continues, "of which Jenner's discovery was a particular case, has been grasped by Pasteur, in a manner and with results which, five short years ago, were simply unimaginable."

In a word, Pasteur has individualized the causes of disease, and

generalized vaccination by disclosing a new method of dealing with the discovered microbes of the viruses of deadly maladies of plants or animals, by mitigating a malignant into a benignant virus. The name vaccination is no longer to be confined to the inoculation of the mitigated virus of small-pox, but of any mitigated virus, whether that of chicken cholera, hog cholera, anthrax, tuberculosis, or any other of many varieties. Adam Smith's theory of the origin of general terms is, that they were all, at first, particular names. The word river, for example, meant, in its first use, a particular stream of water; and he mentions a case, within his knowledge, of an untutored man who attached no other meaning to the word river than that of a particular stream flowing by his cabin.

In reference to the bearing of such labors as these of Pasteur, Prof. Tyndall uses the following strong language in his "Introduction to the Life of Pasteur:" "Never before, during the long period of its history, did a day like the present dawn upon the science and art of medicine. Indeed, previous to the discoveries of recent times, medicine was not a science, but a collection of empirical rules, dependent for their interpretation and application upon the sagacity of the physician. How does England stand in relation to the work going on around her? She is, and must be, behind hand. Scientific chauvinism is not beautiful in my eyes. Still, one can hardly see, without deprecation and protest, the English investigator handicapped in so great a race by short-sighted, mischievous legislation.

"A great scientific theory has never been accepted without opposition. The theory of gravitation, the theory of undulation, the theory of evolution, the dynamical theory of heat—all had to push their way through conflict to victory. And so it has been with the germ theory of communicable diseases. Some outlying members of the medical profession dispute it still. I am told they even dispute the communicability of cholera. Such must always be the course of things as long as men are endowed with different degrees of insight. Where the mind of genius discerns the distant truth, which it pursues, the mind not so gifted often discerns nothing but the extravagance, which it avoids. Names, not yet forgotten, could be given, to illustrate these two classes of minds."

The labors of Pasteur have given the finishing stroke to spontaneous generation. This dream of ignorance is older than Horace, Virgil, and Lucretius, who dress its gross form in poetic language, as does Aristotle, in the prose of philosophy. This heathen conceit wended its its way down the ages, till in the seventeenth century a celebrated alchemist gave as a recipe for producing scorpions: "Scoop out a hole

in a brick; put into it some sweet basil, crushed. Lay a second brick upon the first, so that the hole may be perfectly covered. Expose the two bricks to the sun, and at the end of a few days the smell of the sweet basil, acting as a ferment, will change the herb into real scorpions." And the same philosopher gave as a prescription for the production of mice, to stuff a dirty shirt into a vessel containing a little corn, when the ferment proceeding from the dirty shirt, and the odor of the corn, will, in about three weeks, transmute the grain into mice, full grown, and of both sexes. In the same century, Francesco Redi, 1668, published the first attack on spontaneous generation, maintaining the doctrine, *omne vivum ex vivo*—no life without antecedent life. This doctrine of biogenesis, as distinguished from spontaneous generation of life or of abiogenesis, is in all quarters triumphant. Prof. Huxley, sixteen years ago, in an address before the British Association for the Advancement of Science, sums up the case in these words: "So much for the history of the progress of Redi's great doctrine of Biogenesis, which appears to me, with the limitations I have expressed, to be victorious along the whole line at the present day." Says Pasteur, in a lecture at the Sorbonne, 1864: "There is not one circumstance known at the present day which justifies the assertion that microscopic organisms come into the world without germs, or without parents, like themselves. Those who maintain the contrary have been the dupes of illusions and of ill-conducted experiments, tainted with errors which they know not how either to perceive or avoid. Spontaneous generation is a chimera."

M. Flourens, permanent secretary of the Academy of Sciences, pronounced these words before that body, to wit: "As long as my opinion was not formed I had nothing to say; now it is formed and I can speak. The experiments are decisive." The controversy on the subject of spontaneous generation was at its height about ten years ago, and in December, 1876, in a communication to the Royal Society of London, Prof. Tyndall, describing his own experiments, says: "The experiments have already extended to one hundred and five (105) instances, not one of which shows the least countenance to the doctrine of spontaneous generation." It is obvious to remark that even distinguished scientists are not at liberty to entertain or to express it as their opinion that spontaneous generation has in fact occurred, for it is conceded that the overwhelming evidence of science is against it. It is a matter of no little surprise that both Prof. Tyndall and Prof. Huxley fall under this censure. Moreover, it should not escape attention that thorough going evolution, such as that of Spencer and Haeckel, proceeds on the false and fallacious assumption

of the truth of spontaneous generation, not accepted by Darwin himself.

The vitalising idea of this paper is that practice depends on etiology, that the views on etiology, in the mind of the profession, are determined by the reigning science of the hour; that Pasteur, the scientist, has shed such light on the pathology and the cause of many diseases as to give a new key note for the practice of the future in certain important respects. It is most unwise to exaggerate or underestimate, and it is not pretended that everything practicable or desirable has been accomplished, but doubtless a noteworthy step has been taken towards a more rational practice of medicine. By the aid of sound science, superstition is being dispelled from the dark realm of disease, and rational treatment is still gaining ground by ascertaining and dealing with the true causes, rather than with the symptoms of disease. Abracadabra is a cabalistic word, utterly devoid of meaning, which repeated in a certain way a certain number of times, was formerly supposed to cure fevers and to prevent many diseases; and for its supposed curative and prophylactic virtues, it was figured in triangular form on amulets which were suspended around the neck. I am not aware that the sacred boon of wearing them was ever accorded to the afflicted lower animals. Such discoveries as those just imperfectly sketched, show that these cabalistic amulets are no longer in order.

Another manifest drift of M. Pasteur's labors is that of putting animal medicine, in theory and in practice, on a footing hitherto unrecognized. After making due allowance for the modifying influence of moral qualities and emotions as distinguishing man from lower animals, he holds that "the cause of every contagious malady is physiologically the same in the two groups, and that our bodies, notwithstanding our superior moral qualities, are exposed to the same dangers, to the same disorders as the bodies of animals." There is no good reason for objecting to this view as substantially correct. There are two weighty considerations which give decided emphasis to the importance attached to animal medicine; one relates to the financial interest at stake, and the other to its reflex influence on human medicine. The estimate is official that our national animal losses from one single disease, hog cholera, amount to forty millions a year. Yet its microbe has been discovered and the vaccinations at numerous stations in Europe give promise of its control. And if the figures given be reliable, then over thirty millions of this amount would be saved to us, if the new discovery were completely utilized. In France M. Pasteur's scientific labors have so greatly added to the material

wealth of the country, and especially to agriculture, that Prof. Huxley is quoted as saying that Pasteur's "discoveries suffice of themselves to cover the war indemnity of a thousand millions of dollars paid by France to Germany."

There is here a tangible and brilliant illustration of the value of State aid to scientific labors. It may be of sufficient general interest to state that at the Missouri Agricultural College a laboratory has been established for the cultivation and distribution of vaccine viruses for the use of the profession and of the citizens of the State. Our State veterinarian, a man thoroughly educated for his profession, a member of the faculty of the State University of Missouri, and under whose care this laboratory is placed, is now in France pursuing this subject in the interest of our people, having ample leave of absence for that purpose, and being furnished with suitable credentials by the authorities of the institution and endorsed by the Governor of the State, which will secure for him during his residence abroad, access to the best advantages of the age.

Under the inspirations of these scientific labors abroad, the State veterinarian, Dr. Paul Paquin, was granted leave of absence from February to September, 1886. He was furnished an official letter issued under the seal and signature of the Board of Curators, which was also signed by the President of the University and the Dean of the State Agricultural College and endorsed by the signature of Governor Marmaduke. This document secured him access to the very best advantages whilst resident in France.

The following statement shows the various institutions in which the veterinarian studied, viz: The Histological and Pathalogical laboratory at Charity Hospital, of Paris, director, Dr. Latteux; Cornill's Bacteriological Laboratory at the Paris Medical School, director, Dr. Chantemesse, one of Pasteur's assistants; the laboratories and the surgical clinics; the celebrated Alfort Veterinary School, professors, Teasbot and Nocard, the latter a co-laborer of Pasteur; and finally the laboratory of Mr. Pasteur, witnessing and noting this renowned man's methods of producing hydrophobia-vaccine through the rabbit, and also vaccination against that disease.

In this laboratory the veterinarian was one of the few who had the privilege of attending the conferences of Dr. Perdrix on Prof. Pasteur's methods of cultivation of bacteria and attenuation of virus. Dr. Perdrix, it may be well to state, is one of the assistants of Pasteur, who studied under the great pathologist and bacteriologist—Koch of Germany. So that the veterinarian had the very best advantages for his studies.

The legislature in the Thirty-fourth General Assembly of Missouri having appropriated $5,000 for the experiment of a pathological and vaccinal laboratory in connection with the Agricultural College and State University, we are in hope that the State veterinarian will find time to devote to the study of obscure diseases of animal if not also some of the human family.

We have already started to produce tested and perfectly reliable vaccine against small-pox in man, and arrangements are made for the erection of the veterinarian's laboratory, and for the purchase of all necessary instruments and apparatus for its outfit.

It may also be stated, as likewise indicative of our appreciation of this new advance in the interest of man and lower animals, that the degree of M. C. D.—Medicinæ Comparativæ Doctor, has been provided for in the Missouri University Medical School. Comparative anatomy, comparative physiology and comparative pathology are familiar and need only the addition of comparative therapeutics and practice. The following extract is from the London *Lancet* of 1881, giving an account of a conference in that city: "The discussions which took place at meetings of the conference afforded another proof of the necessity of instituting a chair of comparative pathology at each of our medical schools. Surely a knowledge of animal diseases, in their relation to those in our own species, is of far more moment to the surgeon or physician in the practice of his profession than an acquaintance with zoology or comparative anatomy. Such chairs are established in nearly all, if not all, continental medical schools in which their value has long been recognized. Why is it, then, that we are so slow or so unwilling to adopt what it so manifestly and so urgently required in order to complete the student's education and to render him a more useful and enlightened member of society?"

There seems to be no intelligent ground left for questioning the propriety and duty of medical practice upon the lower animals. The literature of the subject is already ponderous, and many of the distinctive workers are men of first rank with distinction. It is a legitimate question, and one in the line of present progress: Should these two departments of practice be kept sharply distinct and allotted to separate professions, or should they come under the care of one and the same practioner? This is not a topic for dogmatism. There will be difference of opinion, and there will probably be as great a change in the not distant future as in the not distant past. It is now six years since, as chairman of the committee on medical education of the Mis- State Medical Association, the present writer used the following lan- guage in the report published in the proceedings of 1880:

"There is another aspect of medical education—it relates to our indebtedness, not merely to humanity, but to the lower animals, for much of our most valuable knowledge—their ills are so like ours and are so amenable to intelligent treatment. And yet, is it not deemed beneath the dignity of the medical profession to doctor these kindred creatures? Such attention to the lower animals has its reward in the enrichment and culture and scientific information of the observer and experimenter. Their mute and unaffected manifestations give a field of rare observation, and their morbid anatomy is doubtless as strikingly analogous to ours as their normal anatomy; and thus the foundations of the rational treatment of disease must be by such proceedure deepened and broadened. Whatever the objection to vivisection, there is here no obstruction to post mortems."

There seems to be ground for concluding that the injunction of Chomel, not so much to treat disease as patients affected with disease, is losing its axiomatic force. Therapeutics is becoming realistic rather than personal. The history of diseases, according to Dr. B. W. Richardson, shows a gloomy catalogue of fully two hundred and fifty of them, as to which "throughout the whole period of human existence on earth, not one new disease has been added, not one withdrawn." The practice has been honorably pursued through the centuries from Æsculapius to Austin Flint; and yet, within a present lifetime, by one of the most able and distinguished professors of the oldest medical school on the American continent, this startling, but not unparalleled, language was deliberately used in an address to a graduating class: "Let the declaration go forth with all the authority which can be given to it by the combined influence of the whole medical profession—that there is no cure for any disease; no single remedy, no happy combination of remedies for any disease which has ever affected humanity." This grave utterance was put forth April 6, 1850; could it be repeated in 1886; "More light—*Mehr Litch!*" were the last words of the immortal Goethe uttered a little more than fifty years ago as he ordered a servant to open the blinds of his chamber window. In the brief inval that elapsed before his peaceful death, seated quietly in his arm chair, he mutely made signs with his forefinger in the air and traced figures on the shawl that covered his lap. The discoveries of this wonderful age are solving and voicing the riddles of the past.

DOUBLE-ENTRY BOOK-KEEPING FOR FARMERS.

By J. P. Royall, Teacher of Book-keeping in the Missouri State University.

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Ninety per cent. of those who engage in a mercantile business are said to fail; and it is true that the ten per cent. who succeed, while they direct in person the general management of their business are, at the same time, careful in the superintendence of the most minute details. It was said by a very distinguished United States District Judge* of this State, that of twelve hundred cases of bankruptcy which had been brought before his court, only twelve—or one per cent.—of the insolvents kept their accounts in a systematic manner. That is to say, ninety-nine per cent. of the bankrupts, either from carelessness or ignorance, failed to keep their books according to the rules of book-keeping.

The farming business is the most independent, the most successful, the most healthful, as well as the most ancient and respectable of all the occupations of man. Indeed, it is the foundation and mainspring of all industries. Its pecuniary success is not so rapid as that attained in some other kinds of business, nor do those who engage in it count their acquisitions by the millions, as do some of those who enter into speculations of questionable honesty, but by patient industry, reasonable frugality and careful attention to the details—the little things—of his business, the farmer is more generally and more steadily successful than any other business man.

The occupation of the farmer, assisted by nature, is somewhat analogous to that of the manufacturer; he is, at the same time, to a large

*Judge Arnold Krekel.

extent a merchant, and if his munificent mother earth did not annually replenish his capital—the produce and live stock of his farm—he, too, would experience the disastrous failures of his brother tradesman, the merchant. And since the average well-to-do farmer has a greater number of distinct departments in his business than the ordinary merchant, he has more need of double entry book-keeping than the merchant.

In view of the foregoing, it is evident that if the farmer were to keep systematic accounts, not only with the persons with whom he deals, but also with each department of his business, his pecuniary success would be more rapid and more certainly assured. A thorough knowledge of double-entry book-keeping in its application to general business would be very beneficial to the farmer, vastly more so than can be conceived by any one unfamiliar with the subject, for it would enable him to keep his farm accounts with persons, things (property) and causes (losses and gains) with little labor and with satisfaction and assurance of accuracy. But, in the absence of such knowledge of this science, an intelligent farmer, by giving heed to the fundamental principles of double entry, and following carefully the directions contained herein, will find that the result will be both gratifying and remunerative. A strict and careful regard, however, must be paid to these principles, and no deviation from them be made. The more a person uses them, the simpler they become and the easier of application. It is not to be expected that any one without the direction and instruction of a competent teacher, can at once and readily become an accurate and reliable accountant, yet he may, by *using* these rules and principles, be able to keep his accounts in an orderly and satisfactory manner. At the end of each year he will be able to ascertain, not only the *amount* of his profits and losses, but—what is of vast importance—the *sources* of his profits and losses. He will thus be enabled to "check the leaks," and increase his particular and aggregate gains, and, at the same time, he will cultivate and acquire systematic business habits which are very essential to success.

PRINCIPLES.*

The principles of double-entry book-keeping are few and simple. The science of book-keeping is based on the law of equation, or of compensation. It is a law of physics that man can neither create nor annihilate anything. In business a man cannot acquire (or create) a claim upon any person or property without relinquishing a claim upon

*These excerpts on the principles of book-keeping are quoted and adapted from *Royall's Manual of Book-Keeping.*

or owing something or somebody for it. Nor can he be deprived of a claim upon a person or upon property without being owed for it. He cannot owe without being owed, and he cannot be owed without owing. And, therefore, since he is both debtor and creditor in each transaction, it would be superfluous to open or keep an account with himself. Hence, the business man *never* opens an account with himself as a business man. The reason that he is credited for his capital or investment, on beginning business, may be understood if you will allow that, on entering into business, while still retaining his personality as an individual, he assumes another personality as a business man (or merchant), and he maintains this dual personality throughout his business course. If he has capital he must have received it from some source. If he owes no one else for it he must owe himself—the individual. He keeps no account therefore with himself as a business man, but he does keep an account with himself as an individual. Just as when a partnership is formed, the firm is the new personality created. No business firm or house, as for example, Jones & Smith, keeps an account with itself, *i. e.*, with Jones & Smith, but all its accounts are kept with departments of the business, as "Cash," "Bills Receivable," "Profit and Loss," etc., or with other firms, or with individual persons, including each member of the firm.

The person upon whom we have a claim, it is readily admitted, is *debtor*. We may also call property upon which we have a claim, *debtor*. The law which sustains our claim against a person and enforces its payment sustains our claim upon property and maintains us in its use and control much more readily and definitely. If we credit a person who pays us a sum of money, we may as reasonably give credit to a department of our business which produces us a like amount.

All our claims upon persons or things are counted or, more properly, *measured* in *dollars* and *hundredths of dollars* (cents). And all claims against us are *measured*, likewise, in *dollars* and *hundredths*. We may have a certain number of *dollars* in money ("Cash"), a certain number of *dollars* in negotiable promissory notes ("Bills Receivable"), or a certain number of *dollars* in claims upon firms or individual persons (personal accounts). It therefore follows that every business transaction consists of a swap or counter-change of *dollars*. That is, in every business transaction we receive a claim in *dollars* upon some person, thing or cause, and we relinquish or give up a claim in *dollars* upon some other person, thing or cause. *Dollars* are *not*, therefore, necessarily *money*, but are *measures* of value.

In every transaction some person or thing or cause *costs* us a cer-

tain number of *dollars* (or cents), and some person or thing or cause *produces* us the same number of *dollars* (or cents).

That which *costs* us value we have a claim upon.

That which we have a claim upon owes us.

That which owes us is *debtor*.

Therefore, *that which costs us value is Debtor*.

That which *produces us* value has a claim upon us.

That which has a claim upon us we owe.

That which we owe is *creditor*.

Therefore, *that which produces us value is Creditor*.

The following axioms apply to all things in the physical world:

Effect equals Cause.

Reaction equals Action.

Augmentation equals Depletion.

Since the Debtors are those that represent the "effect," the "reaction" or the "augmentation," and the Creditors are those that represent the "cause," the "action" or the "depletion;" it therefore follows that *the Debtors equal the Creditors*. That is, the *sums* of the values of the Debtors *in each case* and *at all times equal* the *sums* of the values of the Creditors.

SUGGESTIONS.

The following is suggested as one of the many plans for a Farmer's Double-Entry Book-keeping. Of course, he should use his own judgment to modify the details of this plan to suit his own convenience and business. It would require a treatise too elaborate for this volume to give directions for all the minute details of book-keeping adapted to the business of all farmers:

Make an inventory of the number or amount and value of each kind of property on hand, such as—

"Cash." (Money on hand.)

"Teams & Tools."* (Work stock and farming utensils and machinery.)

"Cattle;" "Hogs;" "Sheep." (If preferred, these three items may be embraced in the one account of "Live Stock."

"Poultry."

"Farm Produce." (Seed, feed, etc., on hand.)

* Separate accounts may be kept with "Work Stock" and with "Farm Implements," but since they are generally used together, it will be more convenient to keep the one account of "Teams & Tools."

"House and furniture." (Dwelling and its contents, garden, etc.)

Each field, including its improvements, should be separately valued and placed in the inventory. This is preferable to the keeping of the one general account of "Farm," as it will enable you to ascertain or compute the cost and the product of each crop.

Put in the inventory, under separate heads, all kinds or classes of property with which you wish to keep a distinct and separate account. Also place the names of the persons that you owe, and the amount of the indebtedness to each. All these sums added together will be your *gross capital.* Then make another list of all persons and amounts that you owe. The difference between these two sums will, of course, be your *net capital.*

Get an Account Book of six or eight quires, of good heavy paper, the sheets not being smaller than foolscap paper. The book should be ruled somewhat after the form of journal paper. It is sometimes called the "Single-Entry Ledger." Give two pages facing each other to each heading (or name) on your inventory; write this name on the top of the pair of pages allotted to it, with "Dr." on the left page, and "Cr." on the right page; also write this name in the index, followed by the number of one of the pages upon which you have placed it.

If you have a claim upon any person or class of things, write in the money column, on the left hand page, the amount of your claim, preceded (on the same line) by the date and a brief statement of your claim. Of course, your claim upon any person or class of things will be exactly the amount affixed to that name in the inventory.

If you owe anybody, place the amount on the right hand page of the two pages allotted to that person on your Account Book. Allot to yourself (your name) two pages facing each other—just as you have done to other persons—and write the amount of your "Net Capital" in the money column on the right hand page. The sum of all the amounts on the left hand (or "debtor") pages will equal the sum of all the amounts on the right hand (or "creditor") pages. Your book is now open ready to be "kept."

The simple rules for managing accounts with *persons* are these:

"When a person gets into your debt, or you get out of his debt, he is *debtor.*" And,

"When a person gets out of your debt, or you get into his debt, he is *creditor.*"

If he is "Dr." make the entry on the left hand page of his account; if he is "Cr." make the entry on the right hand page of his account.

The plain rules for accounts with things are these:

When anything is bought or traded for, make the account, under

which its kind is placed in the inventory, debtor for the amount it cost you, and give credit to the account representing the thing that produced it, or to the person that you owe for it.

When anything is sold or traded off, credit the account to which it belongs in the inventory, and debit the account that embraces (in the inventory) the thing that you receive for it, or the person that owes you for it. The foregoing rules are embraced in the following brief and comprehensive

RULE TO DETERMINE DEBTORS AND CREDITORS.

That person or thing which *costs* you value is *debtor;* that person or thing which *produces* you value is *creditor.*

In entering each transaction in your book, you will enter upon the creditor side of one account the same amount that you enter upon the debtor side of some *other* account; thus the equality of the sums of all the debtors and the sums of all the creditors will be continually maintained. This is as essentially double entry book-keeping as that which is used in any mercantile business.

The memoranda for each field or crop, and for each kind of live stock, and for each laborer, etc., may be kept upon an ordinary "Monthly Time Book," and entered from this Time Book, in aggregates, to the Ledger, at the end of each month.* Each field or crop should have a separate page upon the Time Book. On the left hand space of the page allotted to a field, write the name of each of the laborers who may be employed upon it, and upon other lines write "Plow Team," "Harrow Team," and such others as may be necessary. When labor is performed upon a field or crop by a man, place 1 (or fraction) opposite the man's name and under the date printed at the top of the page. If the labor is done by man and plow team, put, also, after Plow Team the number of days (or fraction) under the proper date. A separate page on the Time Book should be allotted to the laborers. Upon this page write the name of each laborer on the left hand space, and "keep the time" of each laborer by entering 1 (or fraction) for the day's work (or part thereof) performed by him. At the end of the month charge (or debit) each field for the aggregate days' labor, upon that field, of men and of teams and implements, at the current rate, for all the labor performed, and credit "Teams & Tools" for the proper amount, and credit each man, if hired, for his labor. If the

*A "book-keeper" would also use other books for keeping the memoranda of money received and paid, etc.—such as cash book, day book, etc.—and from them would make some of the monthly entries.

labor is done by yourself, or by a member of your family, credit your own account. The unproductive labor upon the farm, such as taking plow to shop, chopping wood for fuel, etc., should be charged to appropriate accounts; for instance, if you take plow to shop for repairs, charge "Teams & Tools" for your time and the cost of the repairs; and for chopping fire-wood charge "Family Expense." This last account may include all the provisions used by your family. When articles raised upon the farm are used by the family, or by the teams or other live stock for food, credit "Farm Produce." Before charging each field and crediting the laborers, see that the aggregate days' labor charged to the several fields agree with the time of the laborer, as found upon the laborers' page of the time book.

The sum of these suggestions is this: Charge each field, crop, kind of live stock or department of your business with all the labor performed and the seed, feed or other supplies furnished, just as you would charge a neighbor if you had done the same work and furnished the same supplies for him, and credit each field, crop, kind of live stock or other department of your business for the value of all it produces you, just as you would credit a neighbor who had produced you the same amount.

Let the account for each field or crop, be kept for each year separately, and be permanently closed at the end of the year. After a crop has been gathered and its value ascertained in the fall, credit the field for what it has produced you; estimate the value of the land (with the unexhausted manure upon it,) and give the field credit for its value at that time, and charge the same amount to the field which shall follow it (in the rotation of the crops) on the following year.

Each field for the current year will be closed into "Loss & Gain" as directed below. All that is put upon a field in the fall, (labor, manure, seed, etc.,) for the succeeding crop should be charged to a new account for the crop of the next year.

At the end of the year, make another inventory of the value of each field, (excluding the fields of the current year, but including those of the succeeding year to which the former have been transferred) each kind of live stock and other property, similar to the one made at the beginning of the year. Add the money column on the debtor (or left) side of the account with each field, (for next year's crop.) Place this in the inventory as the value of the field. On the account of each kind of live stock, or other property, write in red ink on the right hand side of the account, its value per inventory. Add the two money columns on a slip of paper and find the difference between their sums.

If the creditor side is greater, this difference will be the amount of the *gain;* but if the debtor side is greater, the difference will be the amount of the *loss* upon the account. Open an account for "Loss & gain." If there is a gain upon an account, debit it for the amount of the gain and credit, "Loss & Gain" for the same amount. If there is a loss upon an account, credit it for the amount of the loss and debit "Loss & Gain" for the same amount. Treat each property account in a similar manner. If an account does not represent property nor debt, but represents an incorporeal abstraction, as "Expense," "Discount and Interest," etc., balance it by writing the difference between the two money columns on the side of the less sum, and writing the same amount on the opposite side of "Loss & Gain." After thus balancing each of the property accounts and the incorporeal accounts, find the difference between the debtor and creditor sides of "Loss & Gain." If the creditor side is greater, the difference is your *net gain;* if the debtor side is greater, the difference is your *net loss.* If there is a net gain, debit "Loss & Gain," and credit your own personal account for the difference—this represents an increase of your net capital. If there is a net loss, credit "Loss & gain," and debit your own personal account for the difference—this will represent a decrease of your net capital. The difference between the debtor and creditor sides of your account represents your "*present net capital.*" Write this difference, in red ink, on the less (or debtor) side of your account. It is not necessary to balance and close any other personal account until you have a settlement with the person whom it represents.

Now, close each account in your Ledger that has been balanced, as follows:

Place a ruler across you book immediately under the longer money column. Rule a line, in red ink, under the longer money column, and, without moving the ruler, rule another line under the shorter money column on the opposite side. Add each column, setting the equal sums (directly opposite each other) on the same horizontal line. Rule two parallel lines under each sum, and rule an oblique line on the side of the shorter money column to prevent further entries above the balancing lines. The account is now closed. Reopen by writing, in black ink, below the closing parallel lines, the balance which has been written above in red (if any), upon the side opposite to that upon which the red ink entry was made. Your book is now ready to receive the record of another year's business.

EXAMPLE.

The memoranda for the accompanying *pro forma* set of accounts are furnished by Prof. J. W. Sanborn, Dean of the Agricultural College of the State University, and are based closely upon estimates and tested data found in the introductory article in this volume. Aside from the use of these calculations in forming a set of accounts, the intelligent farmer will doubtless be interested to know the results herein brought out.

Aggregates, instead of details, are generally used in these accounts, since the latter would extend the work beyond reasonable limits; hence, dates are frequently omitted. It will be noticed that the land and the improvements are separately estimated. If their values were estimated together (as is customary) the farm would be counted at sixty dollars per acre instead of at twenty.

The balance upon the "Labor" account shows a larger loss than would appear if all the details were accurately shown. The unproductive labor, if the "Labor" account were strictly kept, would be charged to the several classes of labor, or be charged proportionately to each class. "Family Expenses" may be charged for labor upon the garden, orchard, etc., and for the preparing of fuel, etc.

Instead of making one account of "House & Furniture," the "Furniture" may be consolidated with "Family Expense," and the "House" account apply only to the realty.

The greater the number of the accounts used, the more complicated will be the work, but, if they are accurately kept, the more satisfactory will be the result.

INVENTORY,

Or estimated value of the several fields, kinds of live stock, farming implements, etc., on the farm of John Doe, January 1, 1886:

Corn Field 12 acres land at $20		$240 00	
Value of work on crop to date as per "Corn Field" account		16 50	$256 50
Oat Field, 12 acres land at $20		$240 00	
Work, etc., on crop to date		120 45	360 45
Clover Field, 12 acres land at $20		$240 00	
Unexhausted manure of oat field		42 80	282 80
Wheat Field, 12 acres land at $20		$240 00	
Work, seeding, etc., to date		310 55	550 55
Timothy Field, 24 acres land at $20		$480 00	
Work, etc., to date		119 45	599 45
Pasture & Woods, Pasture, 30 acres at $20		$600 00	
Woods, 18 acres at $20		360 00	960 00
Barns & Sheds, value of buildings on 2 acres			2,500 00
House & Furniture, dwelling, out-houses, garden, orchard, etc., both real (4 acres) and personal property—(condensed from itemized statement)			2,500 00
Total real estate and household furniture			$8,009 75
Cattle, 30 cows at $45	$1,350 00		
30 calves at $20	600 00		
30 yearlings at $30	900 00		
20 steers at $40	800 00	$3,650 00	
Sheep, 100 ewes at $5	$500 00		
25 lambs at $4	100 00		
3 rams at $12	36 00	636 00	
Carried forward		$4,286 00	$8,009 75

INVENTORY—CONTINUED.

Brought forward		$4,286 00	$8,009,75
Hogs, 8 breeding sows at $12 50	$100 00		
50 fall pigs at $2	100 00		
1 boar at $20	20 00	220 00	
Total value of live stock, excluding horses			4,506 00
Farm produce, 84 tons clover and timothy at $6		$504 00	
28 tons corn fodder at $4		112 00	
14 tons oat straw at $4		56 00	
9 tons wheat straw at $3		27 00	
670 bushels corn at 30 cents		201 00	
500 bushels oats at 25 cents		125 00	
20 bushels wheat at 80 cents		16 00	
216 tons manure at 50 cents		108 00	1,149 00
Cash, amount on hand			275 00
Teams & Tools, 5 horses at $150 (teams)		$750 00	
Farming implements (Tools) including burr mill, thresher and steam engine, plows, harness, etc., (condensed from itemized statement)		1,500 00	2,250 00
Gross capital			$16,189 75
LIABILITY.			
McAlester, Bowling & Co.—I owe them balance for farm implements			$189 75
John Doe, my net capital			$16,000 00

DR. CORN FIELD

	VALUATION:—		
	Twelve acres at $20		$240 00
1885. Nov..	To Teams & Tools, plowing 6 days, 3 horses	$10 50	
	" Labor, plowing 6 days, 1 man	6 00	16 50
1886. Jan. 1.	Value at this date of field and crop		$256 50
April..	To Farm Produce, 360 loads manure, at 50 cts	$180 00	
April..	" Teams & Tools, manuring, 4 horses, 16 days	40 00	
	" Labor, manuring, 3 men, 16 days	48 00	268 00
April..	" Labor, harrowing, 1 man, 4 days	$4 00	
	" Team & Tools, harrowing, 2 horses	5 00	9 00
May 1..	" Farm Produce, 2½ bushels corn (seed)	$1 00	
	" Teams & Tools, planting 1½ days	4 50	
	" Labor, planting 1½ days, 1 man	1 50	7 00
May ...	" Labor, cultivating, 17 days	$17 00	
June...	" Teams & Tools, cultivating, 5 days	6 00	23 00
Sept...	" Labor, cutting and shocking		20 00
Oct. ...	" Teams & Tools, husking, 7 days	$8 75	
	" Labor, husking, 39 days	39 00	47 75
	" Labor, hauling fodder, 2 men, 6 days	$12 00	
	" Teams & Tools, hauling fodder, 6 days	13 50	25 50
Dec. 31.	" Interest on $256.50 at 6 per cent		15 40
	" Loss & Gain, net gain on crop for 1886		123 05
			$795 20

OF 1886. CR.

Oct. 31.	By Farm Produce, 960 bushels corn, (80 bushels per acre,) at 30 cts	$288 00	
	40 tons fodder at $4	160 00	$448 00
Dec. 31	" *Oat Field of 1887*, 12 acres at $20	$240 00	
	Two-fifths manure (unexhausted)	107 20	
	Value of field—carried to oat field of next year, (1887.)		347 20
			$795 20

DR. OAT FIELD

	VALUATION :—		
	Twelve acres land at $20	$240 00	
	2-5 unexhausted manure left from corn crop	107 20	$347 20
1885.			
Nov.	To Teams & Tools, plowing 6 days	$7 25	
Nov.	" Labor, plowing 6 days	6 00	13 25
1886.			
Jan. 1	Value at this date of field and crop		$360 45
March	To Teams & Tools, harrowing 4 days	$5 00	
	" Labor, harrowing 4 days	4 00	9 00
	" Farm Produce, 30 bushels seed oats at 30 cents		9 00
	" Labor, sowing, 4 hours fitting	$ 40	
	" Labor, " 1½ days	1 50	
	" Teams & Tools, 1½ days	3 75	5 65
	" Teams & Tools, harvesting—reaper, 3 horses 1½ days	$8 00	
	" Labor, harvesting, 4 men 1½ days	6 00	14 00
	" Labor, hauling to barn, 2 men, 3 days	$6 00	
	" Teams & Tools, hauling to barn, 3 days	3 75	9 75
	" Teams & Tools, threshing, thresher and engine	$12 00	
	" Labor, threshing, 8 men, 1 day	8 00	20 00
	" Interest on $360.45		21 63
	" Loss & Gain, net gain on crop of 1886		109 32
			$558 80

OF 1886. Cr.

Aug ...	By Farm Produce, 720 bushels oats at 25 cents.....	$180 00	
	24 tons straw at $4.....	96 00	$276 00
Dec. 31.	" *Clover Field of 1887*, 12 acres land at $20.....	$240 00	
	1-5 value of manure, unexhausted, left for clover field next year.....	42 80	
	Present value of field carried to the account of next year's Oat Crop.....	.....	282 80
			$558 80

DR. CLOVER

	VALUATION :—		
	Twelve acres land at $20.00	$240 00	
	1-5 value of manure—unexhausted from oat field of last year	42 80	
1886 Jan. 1.	Present value of field and crop		$282 80
	To Cash paid for 144 lbs. seed clover at 7 cents	$10 08	
	" Labor, seeding 1 day	1 00	11 08
June...	" Teams & Tools, cutting 1½ days	$4 50	
	" Labor, cutting 1½ days	1 50	6 00
	" Labor, teddering 1 day (with tedder)	$1 00	
	" Teams & Tools, teddering with tedder 1 day	2 50	3 50
	" Teams & Tools, raking 1⅔ days (1 horse)	$ 90	
	" Labor, raking 1⅔ days	1 65	2 55
	" Labor, heaping, opening and turning 3 days		3 00
	" Labor, hauling to barn, 2 men, 5 days	$10 00	
	" Teams & Tools, hauling to barn, 5 days	6 25	16 25
Aug...	" Teams & Tools, cutting (2d crop) 1½ days	$4 50	
	" Labor, cutting 1½ days	1 50	6 00
	" Labor, teddering 1 day	$1 00	
	" Teams & Tools, teddering 1 day	2 50	3 50
	" Teams & Tools, raking 1⅔ days	$90	
	" Labor, raking 1⅔ days	1 65	2 55
	" Labor, heaping 2 days		2 00
	" Labor, hauling to barn, 2 men 3 days	$6 00	
	" Teams & Tools, hauling to barn 3 days	3 75	9 75
	" Interest on $282 80 at 6 per cent		16 97
Dec. 31.	" Loss & gain, net gain on crop of 1886		162 05
			$528 00

FIELD OF 1886. Cr.

June...	By Farm Produce, 30 tons clover at $6.....	$180 00	
Aug....	By Farm Produce, 18 tons clover at $6.....	108 00	
			$288 00
Dec. 31.	By *Wheat Field for 1887*, 12 acres at $20 (carried to account of wheat field of next year).....		240 00
			$528 00

DR. WHEAT

	VALUATION:—		
1885			
	12 acres of land at $20		$240 00
Sept...	To Teams & Tools, plowing 6 days at $1.25	$7 50	
	" Labor, plowing 6 days at $1.00	6 00	13 50
	" Labor, harrowing 4 days	$4 00	
	" Teams & Tools, harrowing 4 days	5 00	9 00
	" Farm produce, 360 loads manure at 50c	$180 00	
	" Teams & Tools, hauling manure, 16 days, 2 teams	40 00	
	" Labor, hauling and spreading manure, 16 days, 3 men.	48 00	268 00
	" Farm produce, 18 bushels seed wheat at 80c	$14 40	
	" Labor, fitting 4 hours	40	
	" Labor, sowing 1½ days	1 50	
	" Teams & Tools, sowing 1½ days	3 75	20 05
1886			
Jan. 1..	Present value of field and crop		$550 55
June...	To Labor, reaping and shocking, 4 men, 1 day	$4 00	
	" Teams & Tools, reaping, 3 horses and reaper, 1 day.	10 00	14 00
	" Teams & Tools, hauling to barn, 3 days	$3 75	
	" Labor, hauling to barn, 3 days, 2 men	6 00	9 75
	" Labor, threshing, 8 men, 1 day	$8 00	
	" Teams & Tools, threshing, thresher and engine	12 00	20 00
July...	" Labor, marketing, 1 man, 6 days	$6 00	
	" Teams & Tools, marketing, hauling 5 days	6 25	12 25
	" Interest on $550, 1 year, at 6 per cent		33 00
	" Loss & Gain, net gain on crop of 1886		163 65
			$803 25

FIELD OF 1886. CR.

By Farm Produce, 480 bushels wheat, at 80c.....	$384 00	
24 tons straw, at $3.00.....	72 00	$456 00
By Timothy Field for 1887:		
12 acres at $20.00.....	$240 00	
2-5 cost of manure, unexhausted and left for Timothy field of next year.....	107 20	347 20
		$803 20

DR. TIMOTHY

	VALUATION :—		
	24 acres land at $20	$480 00	
	2-5 manure, unexhausted, from wheat crop last year	107 20	$587 20
	To Cash paid for 4½ bushels seed at $2.50	$11 25	
	" Labor, sowing	1 00	12 25
1886. Jan. 1..	Present value of field and crop		$599 45
June...	To Labor, cutting, 3 days	$3 00	
	" Teams & Tools, cutting 3 days	9 00	12 00
	" Teams & Tools, teddering (with tedder), 2 days	$5 00	
	" Labor, Teddering (with tedder), 2 days	2 00	7 00
	" Labor, raking, 2½ days	$2 50	
	" Teams & Tools, raking, 2½ days	1 38	3 88
	" Labor, heaping, 2½ days		2 50
	" Labor, hauling to barn, 2 men, 5 days	$10 00	
	" Teams & Tools, hauling to barn, 5 days	6 25	16 25
July....	" Teams & Tools, cutting (second crop), 3 days	$9 00	
	" Labor, cutting (second crop), 3 days	3 00	12 00
	" Labor, Teddering, 2 days	$2 00	
	" Teams & Tools, teddering, 2 days	5 00	7 00
	" Teams & Tools, raking, 2½ days	$1 37	
	" Labor, raking, 2½ days	2 50	3 87
	" Labor, heaping, 2½ days		2 50
	" Labor, hauling to barn, 2 men, 4 days	$8 00	
	" Teams & Tools, hauling to barn, 4 days	5 00	13 00
	" Interest on $600 1 year		36 00
	" Loss & Gain—net gain on crop of 1886		268 55
			$984 00

FIELD OF 1886. CR.

June...	By Farm Produce, 54 tons hay at $6	$324 00	
July....	" Farm Produce, 30 tons hay at $6	180 00	$504 00
Dec. 31.	" *Timothy Field of 1887*—12 acres at $20, carried to account of Timothy Field of 1887	$240 00	
	" *Corn Field of 1887*—12 acres at $20, carried to account of corn field of 1887	240 00	480 00
			$984 00

DR. PASTURE AND

	INVENTORY:—		
1886.			
Jan. 1..	30 acres pasture at $20	$600 00	
	18 acres woods at $20	360 00	$960 00
	To Interest on $960 at 6 per cent		57 60
	" Cash paid for cutting rails and repairing fence		25 00
	" Loss & Gain, net gain		157 40
			$1,200 00
Dec. 31.	Balance (from old account)		$960 00

DR. BARNS AND

1886.			
Jan....	INVENTORY:—		
	Value of 2 acres land, with buildings, etc.		$2,500 00
	To Cash paid for additions and repairs		75 00
	" Interest on $2,500, at 6 per cent.		150 00
			$2,725 00
1887.			
Jan 1..	Inventory from old account		$2,500 00

WOODS. Cr.

1886.			
Dec. 31.	By Cattle, for grazing 30 cows		$240 00
	Balance to new account :—		
	Value 30 acres pasture at $20	$600 00	
	Value 18 acres woods at $20	360 00	960 00
			$1,200 00

SHEDS. Cr.

1886.				
Dec. 31.	By Cattle, for sheltering cattle		$75 00	
	" Sheep, for sheltering sheep		20 00	
	" Hogs, for sheltering hogs		25 00	
	" Teams & Tools, for sheltering horses	$15 00		
	For sheltering tools	$15 00	30 00	$150 00
1887. Jan. 1.	" Loss & Gain, depreciation by use			75 00
	Inventory, present value, carried to new acc't.			2,500 00
				$2,725 00

DR. HOUSE (DWELLING)

1886.	INVENTORY:—		
Jan. 1.	Value of residence, 4 acres land, garden,		
	orchard, etc.....	.....	$2,500 00
Oct. 1.	To cash paid for repairs	$30 00	
	paid for repainting.....	10 00	40 00
	paid for new furniture.....	36 00	
	paid for carpet.....	25 00	
			61 00
Dec. 31.	To interest on $2,500, at 6 per cent.....	.....	150 00
			$2,751 00
	Inventory from old account.....	.....	$2,500 00

AND FURNITURE. Cr.

1886. Dec. 31.	By Family Expense, for use of furniture, dwelling and grounds	.....	$251 00
	Inventory to new account:—Value of dwelling, grounds and furniture--carried	.....	2,500 00
			$2,751 00

DR. CATTLE

	INVENTORY:—		
1886.			
Jan. 1..	30 cows at $45	$1,350 00	
	30 calves at $20	600 00	
	30 yearlings at $30	900 00	
	20 steers at $40	800 00	$3,650 00
Dec. 31.	To Farm Produce, 40 tons fodder at $4	$160 00	
	24 tons oat straw at $4	96 00	
	24 tons wheat straw at $3	72 00	
	85 tons hay at $6	510 00	
	67.6 tons grain at $12	811 20	
	39,600 quarts skim milk fed to calves at ½ cent per quart	198 00	1,847 20
	" Pasture, 30 cows at $8		240 00
	" Cash, paid pasturage of 30 yearlings at $5	$150 00	
	paid pasturage of 20 steers at $7	140 00	290 00
	" Labor, milking, care of dairy	$300 00	
	packing and marketing 7,500 pounds butter	100 00	
	care of cattle, feeding, etc	200 00	600 00
	" Barns and Sheds for shelter		75 00
	" Cash paid for 20 head steers 900 lbs. each, 18,000 lbs. at 4 cents	$720 00	
	" Cash paid for salt for cattle and butter	35 00	755 00
	" Interest for interest on $3,650 at 6 per cent		219 00
	" Teams & Tools for marketing butter, etc		20 00
	" Loss & Gain, net gain		1,401 80
			$9,098 00
	Balance per inventory from old account		$3,600 00

CR.

1886.	By Farm Produce, 250 lbs. butter per cow, 7,500 lbs. at 25 cents	$1,875 00	
	" Farm Produce, 60,000 quarts skim milk—39,600 quarts fed to calves at ½ cent	198 00	
	" Farm Produce, 20,400 quarts fed to pigs at ½ cent	102 00	
	" Farm Produce, 2 tons manure for ton of food eaten, 481 tons at 50 cents	240 50	$2,415 50
	" Cash received for 30 head of steers and heifers sold, each 1,350 lbs. at 4½	1,822 50	
	" Cash received for 20 head (purchased) steers, each 1,400 lbs. at 4½ cents	1,260 00	3,082 50
Dec. 31.	*Inventory*:—Value of cattle at the close of year		$3,600 00
			$9,098 00

DR. SHEEP

	INVENTORY:—		
1886. Jan. 1.	100 ewes at $5	$500 00	
	25 lambs at $4	100 00	
	3 rams at $12	36 00	$636 00
Dec. 31.	To Farm Produce 25.3 tons hay at $6	$151 80	
	9.1 tons grain at $12	109 20	261 00
	" Cash paid for pasture for sheep and lambs	$175 00	
	" Cash paid for salt for sheep and lambs	5 00	180 00
	" Labor, tending, shearing, etc		75 00
	" Interest, interest on $636 at 6 per cent		38 16
	" Barns & Sheds, for shelter		20 00
	" Loss & Gain, net gain		110 84
			$1,321 00
Dec. 31.	Balance, per inventory, brought from old account		$617 75

Cr.

1886.	By Cash, 25 old ewes at $4	$100 00	
	75 lambs at $4	300 00	
	1,045 pounds wool at 25 cents	261 25	$661 25
	" Farm Produce, 70 tons manure at 60 cents		42 00
Dec. 31.	*Inventory:*— Carried to new account:—100		
	ewes at $5	$500 00	
	25 lambs at $3.75	93 75	
	2 rams at $12 (1 ram dead)	24 00	617 75
			$1,321 00

DR. HOGS

	INVENTORY :—		
1886. Jan. 1..	8 breed-sows at $12.50	$100 00	
	50 fall pigs at $2.00	100 00	
	1 boar at $20.00	20 00	$220 00
Dec....	To Farm Produce, 16.4 tons grain (meal) for sows and boar at $12.00	$195 20	
	36.5 tons meal for 50 fall and 50 spring pigs (900 lbs. each) at $12.00	438 00	
	20,400 quarts skim milk fed to pigs at ½ cent per quart	102 00	735 20
	" Labor, for care		100 00
	" Interest on $220 at 6 per cent		13 20
	" Barns & Sheds, for shelter		25 00
	" Loss & Gain, net gain		66 50
			$1,159 90
Dec. 31.	Balance, per inventory, brought from old account		$207 00

Cr

1886.			
Nov. 30.	By Cash, 100 shoats, sold, weight, 22,500 lbs. at 4c.	.....	$900 00
Dec. 31.	" Farm Produce, manure ($1.00 for each ton of food)..	.....	52 90
	Inventory:—8 sows, $11.50.....	$92 00	
	50 fall pigs at $2.00.....	100 00	
	1 boar.....	15 00	207 00
			$1,159 90

DR. FARM

1886.	INVENTORY:—		
Jan....	84 tons hay at $6	$504 00	
	28 tons fodder at $4	112 00	
	14 tons oat straw at $4	56 00	
	9 tons wheat straw at $3	27 00	
	670 bushels corn at 30 cents	201 00	
	500 bushels oats at 25 cents	125 00	
	20 bushels wheat at 80 cents	16 00	
	216 bushels manure at 50 cents	108 00	$1,149 00
	To Wheat Field, 480 bushels wheat at 80c....$384 00 24 tons straw at $3..... 72 00	$456 00	
June & July..	" Timothy Field, 84 tons hay at $6	504 00	
Aug....	" Clover Field, 48 tons clover at $6	288 00	
Aug....	" Oat Field, 720 bushels oats.....$180 00 24 tons straw..... 96 00	276 00	
	" Corn Field, 960 bushels corn at 30 cents..$288 00 40 tons fodder at $4..... 160 00	448 00	1,972 00
	" Cash, 101 tons grain purchased at $12		1,212 00
	" Cattle, 7,500 lbs. butter at 25 cents	$1,875 00	
	60,000 quarts skim milk ½ cent	300 00	
	481 tons manure at 50 cents	240 50	2,415 50
	" Sheep, 70 tons manure at 60 cents		42 00
	" Hogs, 52.9 tons manure at $1		52 90
	" Teams & Tools, 51 tons manure at 50 cents		25 50
			$6,868 90
Dec. 31.	Balance, per inventory, from old acc't		$1,171 40

PRODUCE. Cr.

1886.			
March..	By Oat Field, 30 bushel seed oats at 30 cents		$9 00
	" Corn Field, 360 loads manure at 50 cents	$180 00	
	2½ bushels seed corn	1 00	181 00
	" Wheat Field, 360 loads manure at 50 cents	$180 00	
	18 bushels seed wheat at 80 cents	14 40	194 40
	" Cattle, hay and straw fed cattle	$838 00	
	grain and meal fed cattle	811 20	
	39,600 quarts skim milk fed calves	198 00	1,847 20
	" Sheep, hay, $151.80; grain, $109.20		261 00
	" Hogs, 52.9 tons grain fed to hogs	$633 20	
	20,400 quarts skim milk fed pigs	102 00	735 20
	" Teams & Tools, 16.4 tons hay fed to 5 horses at $6	$98 40	
	9.1 tons grain fed to 5 horses at $12	109 20	207 60
	" Cash, 7,300 lbs. butter sold	$1,825 00	
	" Family Expenses, 200 lbs. butter consumed by family	50 00	1,875 00
	" Cash, 480 bushels wheat sold		384 00
Dec. 31..	*Inventory*, carried to new account:		
	89 tons hay at $6	$534 00	
	28 tons fodder at $4	112 00	
	14 tons oat straw at $4	56 00	
	9 tons wheat straw at $3	27 00	
	695 bushels corn at 30 cents	208 50	
	500 bushels oats at 25 cents	125 00	
	150.9 tons manure	108 90	1,171 40
	" Loss & Gain (fractions of tons omitted in the above)		3 10
			$6,868 90

DR. CASH

1886. Jan. 1.	Amount on hand			$275 00
	To Farm Produce, received for 480 bushels wheat sold Columbia mills at 80 cents	$384 00		
	Received for 7,300 pounds butter sold at 25 cts.	1,825 00		2,209 00
	" Sheep, received for 25 old ewes sold at $4	100 00		
	Received for 75 lambs sold at $4	300 00		
	Received for 1,045 pounds wool at 25 cents	261 25		661 25
	" Hogs, received for 100 shoats, 22,500 pounds sold at 4 cents			900 00
	" Cattle, received 30 steers and heifers, 40,500 pounds at 4½ cents	1,822 50		
	Received for 20 steers, 28,000 pounds at 4½ cents	1,260 00		3,082 50
				$7,127 75
Dec. 31.	Balance from old account			$2,249 67

			Cr.
	By Labor paid 4 (extra) hands threshing 1 day....	$4 00	
	" Labor paid 4 (extra) hands threshing 1 day....	4 00	$8 00
	" Teams & Tools, paid B. & A. for horse shoeing	$25 00	
	paid B. A. for repairs of machinery, per recei ted account	38 00	
	paid S. Conley for new wagon	60 00	
	paid S Conley for new plow..	17 00	140 00
	" Labor, paid H. Brown's wages, 1 year.....	$325 00	
	paid A. Smith's wages, 1 year.....	300 00	
	paid S. Jones' wages, 1 year.....	300 00	
	paid T. Johnston wages, 1 year.....	275 00	1,200 00
	" Clover Field, paid for 144 pounds seed clover at 7 cents.....	$10 08	
	" Timothy Field, paid for 4½ bushels seed timothy at $2.50.....	11 25	21 33
	" Cattle, paid for 20 steers, 18,000 pounds at 4 cts	$720 00	
	paid for salt for butter and for cattle...	35 00	
	paid for pasturing 30 yearlings and 20 steers.....	290 00	1,045 00
	" Sheep, paid for pasturing sheep.....	$175 00	
	paid for salt for sheep.....	5 00	180 00
	" Barns & Sheds, paid for additions and repairs.....	.....	75 00
	" Pasture & Woods, paid for repairing fence....	.....	25 00
	" House & Furniture, paid for repairing dwell'g	$30 00	
	paid for repaint'g dwell'g.	10 00	
	paid for house and kitchen furniture..... ...	36 00	
	paid for carpet.....	25 00	101 00
	" Family Expense, paid sundry expenses, etc., for family living.....	.....	681 00
Oct. 16.	" McAlester, Bowling & Co., paid their account.	.....	189 75
	" Farm Produce, paid for 101 tons grain at $12..	.. ..	1,212 00
Dec. 31.	*Balance to new account*.....	.....	2,249 67
			$7,127 75

DR. TEAMS AND

	INVENTORY (Condensed :)		
1886. Jan. 1..	Five work horses at $150, (teams).....	$750 00	
	Farming implements and machinery, as per itemized inventory, (tools).....	1,500 00	$2,250 00
	To Cash paid for repairs of tools.....	$38 00	
	paid for new wagon and plow.....	77 00	115 00
	" Barns & Sheds for shelter of teams (and horse feed).....	$15 00	
	" Barns & Sheds for shelter of tools, etc.....	15 00	30 00
	" Farm Produce, 16.4 tons hay (for horses,) at $6....	$98 40	
	9.1 tons grain (for horses,) at $12...	109 20	207 60
	" Cash paid Broughton & Adams for horse-shoeing, per bill.....	.....	25 00
	" Labor for care of horses, feeding, etc.....	.....	80 00
	" Interest, interest on $2,250, at 6 per cent.....	.....	135 00
			$2,842 60
Dec. 31.	Balance from old account.....	.....	$2,300 00

TOOLS. Cr.

1886. April.	By Corn Field, hauling manure, (4 horses and wagons, 16 days)	$40 00	
	" Corn Field, harrowing, (2 horses 4 days)	5 00	
May ...	planting, 1½ days	4 50	
June...	cultivating, 5 days	6 00	
Oct....	husking, 7 day	8 75	
Oct	hauling fodder, 6 days	13 50	$77 75
Oct	" Oat Field, (as per oat field account)	.....	32 50
	" Clover Field (as per clover field account)	.....	25 80
	" Wheat Field (as per wheat field account)	.....	32 00
	" Timothy Field (as per timothy field account)	.....	42 00
Nov. ..	" Corn Field, plowing for next years's crop	.....	10 50
Nov....	" Oat Field, plowing for next year's crop	.....	7 25
Sept....	" Wheat Field, hauling manure next year's crop	$40 00	
	plowing for next year's crop	7 50	
	harrowing for next year's crop	5 00	
	sowing for next year's crop	3 75	56 25
	Cattle, marketing butter and driving cattle	.....	20 00
	Farm Produce, 51 tons manure from horses, at 50 cts	.....	25 50
	Loss & Gain, net loss	.....	213 05
	Balance, value per inventory, carried to new account	....	2,300 00
			$2,842 60

DR. LABOR

1886. Dec. 31.	To Cash paid 4 men threshing wheat	$4 00	
	paid 4 men threshing oats	4 00	
	paid H. Brown wages 1 year	325 00	
	paid A. Smith wages 1 year	300 00	
	paid S. Jones wages 1 year	300 00	
	paid T. Johnston wages 1 year	275 00	$1,208 00
	" John Doe, (farmer), allowed to myself for my own work and supervision of the farm		600 00
			$1,808 00

CR.

1886. April..	By Corn Field, hauling and scattering manure, 3 men 16 days, at $1	$48 00	
	harrowing, 4 days	4 00	
May 1&2	planting, 1½ days	1 50	
June...	cultivating, 17 days	17 00	
Sept...	cutting, etc., 20 days	20 00	
Sep&Oc	husking 39 days	39 00	
"	hauling fodder 6 days, 2 men	12 00	$141 50
Dec. 31.	" Oat Field (as per oat field account)		25 90
"	" Clover Field, (as per clover field account)		30 30
"	" Wheat Field, (as per wheat field account)		24 00
"	" Timothy Field, (as per timothy field account)		38 00
Nov....	" Corn Field, plowing for next year's crop		6 00
"	" Oat Field, plowing for next year's crop		6 00
Sept....	" Wheat Field, plowing for next year's crop	$6 00	
	harrowing for next year's crop	4 00	
	hauling and spreading manure	48 00	
	fitting seed wheat	40	
	sowing seed wheat for next year	1 50	59 90
	" Timothy Field, sowing seed timothy for next year		1 00
	" Cattle, milking, care of dairy	$300 00	
	" Packing and marketing butter	100 00	
	" Care of cattle, feeding, etc.	200 00	600 00
	" Sheep, tending, shearing, etc., (per sheep acct.)		75 00
	" Hogs, tending, feeding, etc., (per hog acct.)		100 00
	" Teams & Tools, care of horses, feeding, etc		80 00
	" Loss & Gain, loss		620 40
			$1,808 00

Dr. DISCOUNT AND

1886. Dec. 31.	To Loss & Gain, gain.....		$885 96
			$885 96

INTEREST. CR.

1886.			
Dec. 31.	By Corn Field, interest on $256.50 at 6 per cent.....	$15 40	
	" Oat Field, interest on $360.45 at 6 per cent.....	21 63	
	" Clover Field, interest on $282.80 at 6 per cent	16 97	
	" Wheat Field, interest on $550.00 at 6 per cent.....	33 00	
	" Timothy Field, interest on $600.00 at 6 per cent.....	36 00	
	" Pasture & Woods, interest on $960.00 at 6 per cent....	57 60	
	" Barnes & Sheds, interest on $2,500.00 at 6 per cent...	150 00	
	" House & Furniture, interest on $2,500.00 at 6 per cent..	150 00	$480 60
	" Cattle, interest on $3,650.00 at 6 per cent.....	$219 00	
	" Sheep, interest on $636.00 at 6 per cent.....	38 16	
	" Hogs, interest on $220.00 at 6 per cent.....	13 20	270 36
	Teams & Tools, interest on $2,250.00 at 6 per cent....	.....	135 00
			$885 96

Dr. FAMILY

1886. Dec.	To Cash paid for clothing for self	$50 00	
	paid for clothing for wife	50 00	
	paid for clothing for 3 children	90 00	
	paid J. N. Belcher for groceries	150 00	
	paid O'Rear, Baker & Co., flour	20 00	
	paid for 20 bushels potatoes, $6; fresh vegetables and fruits, $50*	56 00	
	paid for meat	100 00	
	paid for fuel	40 00	
	paid for charity, pleasure and miscellaneous	125 00	$681 00
	" Farm Produce, 200 pounds butter, at 25 cents		50 00
Dec. 31.	" House & Furniture, use of dwelling, etc		251 00
			$982 00

Dr. LOSS AND

1886. Dec. 31.	To Barns & Sheds, loss	$75 00
	" Farm Produce, loss	3 10
	" Teams & Tools, loss	213 05
	" Labor, loss	620 40
	" Family Expense, loss	982 00
	" John Doe, net gain on this year's business, carried to his account	1,555 57
		$3,449 12

*If fruits and vegetables are raised in the garden of the owner, then the account of "House & Furniture," (which includes orchard and garden) should be credited.

EXPENSE. Cr.

1886.			
Dec. 31.	By Loss & Gain, loss		$982 00
			$982 00

GAIN. Cr.

1886.			
Dec. 31.	By Corn Field (of 1886), gain	$123 05	
	" Oat Field (of 1886), gain	109 32	
	" Clover Field (of 1886), gain	162 05	
	" Wheat Field (of 1886), gain	163 65	
	" Timothy Field (of 1886), gain	268 55	$826 62
	" Pasture & Woods, gain		157 40
	" Cattle, gain	$1,401 80	
	" Sheep, gain	110 84	
	" Hogs, gain	66 50	1,579 14
	" Interest		885 96
			$3,449 12

Dr. JOHN DOE (OWNER

1886 Jan. 1.	To McAlester, Bowling & Co., balance due them.....	.....	$189 75
Dec. 31.	Balance, my net capital at close of year, 1886.	.....	18,155 57
			$18,345 32

Dr. McALESTER,

1886 Oct. 16.	To Cash, paid them in full of account.....	.....	$189 75

OF THE FARM). Cr.

1886 Jan. 1..	By Sundries, 126 acres land with their improvements, preparation, etc., and household furniture, etc.	$8,009 75	
	" Sundries, live stock, per inventory	4,506 00	
	" Farm Produce, per inventory	1,149 00	
	" Teams & Tools, per inventory	2,250 00	
	" Cash, amount on hand, per inventory	275 00	$16,189 75
Dec. 31.	" Labor, for work and superintendence		600 00
	Loss & Gain, net gain on business of this year (1886)		1,555 57
			$18,345 32

BOWLING & CO. Cr.

1886 Jan. 1..	Balance due them, as per inventory		$189 75

INVENTORY.

Estimated value of the several Fields, kinds of Live Stock, Farming Implements, etc., on the farm of John Doe, December 31, 1886.

Corn Field, value of land and preparation for 1887		$256 50	
Oat " " " "		360 45	
Clover " " " "		282 80	
Wheat " " " "		550 55	
Tim'thy " " " "		599 45	
Pasture & Woods, value of land		960 00	
Barns & Sheds, value of land and improvements		2,500 00	
House & Furniture " "		2,500 00	$8,009 75
Cattle		$3,600 00	
Sheep		617 75	
Hogs		207 00	
			4,424 75
Farm Produce			1,171 40
Cash			2,249 67
Teams & Tools			2,300 00
Total capital at close of 1886			$18,155 57
John Doe, balance of his account	$16,600 00		
" his net gain	1,555 57	$18,155 57	$18,155 57

CROP STATISTICS FOR 1886.

Estimated area and yield of the principal crops of the State for the year 1886, as compiled from the returns of crop-correspondents :

Name of Crop.	Total Acreage.	Yl'd per Acre.	Total Yield.
*Wheat	1,662,721	13.2 bushels.	21,986 00 bu.
Corn	6,292,069	23.8 "	149,751,242 "
Oats	1,238,242	26.8 "	33,184.885 "
Buckwheat	5,107	14.7 "	75,072 "
Tobacco	14,727	708.3 pounds.	10,431,134 lbs.
Barley	6,305	21. bushels.	132,405 bu.
Potatoes (Irish)	81,366	60.2 "	4,898,269 "
Potatoes (Sweet)		72.9 "	
Hemp		681.5 pounds.	
Broomcorn		955. "	
Sorghum		83.2 gallons.	
Flax		9.4 bushels.	
Beans (Navy, etc.)		14. "	
Beans (Castor)		12.3 "	
Hay (Timothy)		1.4 tons.	
Hay (Clover)		1.7 "	

Average yield of Apples	75.5 per cent.
Corn—quality compared with an average year	84. per cent.
Potatoes (Irish)—quality compared with 1885	89.1 per cent.
Potatoes (Sweet)—quality compared with 1885	83.5 per cent.
Wheat—area sown compared with 1885	102. per cent.
Wheat—present condition compared with an average year	100.4 per cent.
Rye—area sown compared with 1885	91. per cent.
Rye—area cut compared with 1885	90.6 per cent.
Cotton—present area compared with 1885	97.7 per cent.

*Estimates on the yield of wheat were made for August 1, but later reports are more conservative. Hence we take the Government estimate made in December, for ours.

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